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U.S. DEPARTMENT OF ENERGY
FOSSIL ENERGY

PUBLICATIONS
OF THE
OAK RIDGE NATIONAL LABORATORY
FOSSIL ENERGY PROGRAM

October 1, 1991, through March 31, 1993

Compiled by

Paul T. Carlson

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MASTER

PREVIOUS REPORTS IN THIS SERIES

P. T. Carlson, *Bibliography of Publications of the Oak Ridge National Laboratory Fossil Energy Program, October 1, 1974, through September 30, 1989*, ORNL-6595, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, December 1989.

P. T. Carlson, *Publications of the Oak Ridge National Laboratory Fossil Energy Program, October 1, 1989, through September 30, 1991*, ORNL-6685, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, December 1991.

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PUBLICATIONS OF THE OAK RIDGE NATIONAL LABORATORY
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1. INTRODUCTION

The Oak Ridge National Laboratory (ORNL) Fossil Energy Program, organized in FY 1974 as the Coal Technology Program, involves research and development activities for the Department of Energy (DOE) Assistant Secretary for Fossil Energy that cover a wide range of fossil energy technologies. The principal focus of the Laboratory's fossil energy activities relates to coal, with current emphasis on materials research and development; environmental, health and safety research; and the bioprocessing of coal to produce liquid or gaseous fuels.

This bibliography covers the period of October 1, 1991, through March 31, 1993, and is a supplement to the earlier bibliographies in this series (see page iii). It is the intent of this series of bibliographies to list only those publications that can be conveniently obtained by a researcher through relatively normal channels. The publications listed in this document have been limited to topical reports, open literature publications, full-length papers in published proceedings of conferences, and books and book articles.

A major part of the Fossil Energy Program is the Advanced Research and Technology Development (AR&TD) Materials Program.^{1,5} The objective of the AR&TD Materials Program is to conduct research and development on materials for fossil energy applications, with a focus on the longer-term needs for materials with general applicability to the various fossil fuel technologies. The Program includes research aimed at a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial improvement in plant operations and reliability. Work on the Program is conducted at national and government laboratories, universities, and industrial research facilities. The research conducted on the Program is divided among the following areas: (1) ceramics, (2) new alloys, (3) corrosion research, and (4) program development and technology transfer. In other materials-related research, advanced ceramic membranes are being developed and tested for use in gas separation and filtration applications.

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The environmental, health, and safety (EH&S) activities on the Fossil Energy Program address documentation required by the National Environmental Policy Act (NEPA) and other environmental support to DOE Headquarters and the DOE Energy Technology Centers. Environmental support is also provided to the DOE Oil Research Program.

Coal conversion work at ORNL involves the evaluation of coal-derived liquids produced by mild gasification processes and the bioprocessing of coal. Evaluation of the coal liquids includes physical, chemical, and combustion properties. The bioprocessing of coal is being explored through the use of microorganisms to convert coal into useful liquid products. Research is also being conducted on the structure and chemistry of coal surfaces and interfaces to understand the complex processes and reactions occurring during the combustion of coal.

Coal combustion research is concerned with the combustion of mild gasification products and the analysis of deterministic chaos in fluidized-bed combustion processes. Support is also provided to DOE and the Government of India in the establishment of fluidized-bed combustion facilities.

Work for the Strategic Petroleum Reserve (SPR) Program is concerned with the assessment of alternative methods of financing oil acquisition and the development of models associated with these assessments for the Strategic Petroleum Reserve.

-
1. P. T. Carlson, *Advanced Research and Technology Development Fossil Energy Materials Program Consolidated Bibliography of Publications, October 1, 1979, through April 30, 1986*, ORNL/FMP-86/5, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, August 1986.
 2. P. T. Carlson, *Advanced Research and Technology Development Fossil Energy Materials Program Consolidated Bibliography of Publications, October 1, 1979, through April 30, 1987*, ORNL/FMP-87/3, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, September 1987.
 3. P. T. Carlson, *Consolidated Bibliography of Publications of the DOE Fossil Energy Advanced Research and Technology Development (AR&TD) Materials Program, May 1, 1987, through May 31, 1989*, ORNL/FMP-89/3, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, June 1989.
 4. P. T. Carlson, *Publications of the Fossil Energy Advanced Research and Technology Development Materials Program, June 1, 1989, through March 31, 1991*, ORNL/FMP-91/3, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, June 1991.
 5. P. T. Carlson, *Publications of the Fossil Energy Advanced Research and Technology Development Materials Program, April 1, 1991, through March 31, 1993*, ORNL/FMP-93/3, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, June 1993.
-

2. MATERIALS RESEARCH AND DEVELOPMENT

2.1 PROGRAM DEVELOPMENT AND TECHNOLOGY TRANSFER

2.1.1 Topical Reports

L. R. White and T. M. Kafka, *Fabrication of Commercial-Scale Fiber-Reinforced Hot-Gas Filters by Chemical Vapor Deposition*, ORNL/Sub/89-SB482/01, 3M Company, St. Paul, MN, November 1992.

2.1.2 Open Literature Publications

William E. Hollar, Jr., and J. J. Kim, "Review of VLS SiC Whisker Growth Technology," *Ceram. Eng. Sci. Proc.* 12, 979-91 (July/August 1991).

K. Natesan, "Historical Perspectives on Fossil Energy Materials R&D," *Materials & Components in Fossil Energy Applications* 100, 4 (October 1992).

2.1.3 Papers in Conference Proceedings

William E. Hollar, Jr., G. DeMunda, J. Kim, and W. Mills, "Engineering Scale Development of the Vapor-Liquid-Solid (VLS) Process for the Production of Silicon Carbide Fibrils," pp. 31-40 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

J. J. Kim, William E. Hollar, S. Chwastiak, and W. H. Mills, "Engineering Scale Development of the Vapor-Liquid-Solid (VLS) Process for the Production of Silicon Carbide Whiskers," pp. 65-73 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

L. R. White and T. M. Kafka, "Fabrication of Commercial-Scale Fiber-Reinforced Hot-Gas Filters by Chemical Vapor Deposition," pp. 25-32 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

2.2 CERAMICS

2.2.1 Topical Reports

B. Z. Egan, S. P. N. Singh, D. E. Fain, G. E. Roettger, and D. E. White, *Gas Separation Using Inorganic Membranes*, ORNL/TM-12068, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, April 1992.

D. E. Fain, G. E. Roettger, and D. E. White, *Development of Ceramic Membranes for Gas Separation - FY 1990 Development Activities*, K/QT-413, Martin Marietta Energy Systems, Inc., Oak Ridge K-25 Site, June 1991.

R. A. Lowden and R. D. James, *High Temperature Corrosion of Nicalon®/SiC Composites*, ORNL/TM-11893, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, August 1991.

D. L. Mohr and T. L. Starr, *Polyorganosilazane Preceramic Binder Development of Reaction Bonded Silicon Nitride Composites*, ORNL/Sub/87-00184/03, Georgia Institute of Technology, Atlanta, 1992.

T. L. Starr and A. W. Smith, *Finite Volume Model for Forced Flow/Thermal Gradient Chemical Vapor Infiltration*, ORNL/Sub/85-55901/02, Georgia Institute of Technology, Atlanta, 1991.

T. L. Starr and A. W. Smith, *Modeling of Forced Flow/Thermal Gradient Chemical Vapor Infiltration*, ORNL/Sub/85-55901/03, Georgia Institute of Technology, Atlanta, 1992.

W. W. Stinchcomb, K. L. Reifsnider, and T. J. Dunyak, *Investigation of Properties and Performance of Ceramic Composite Components*, ORNL/Sub/87-SA946/02, Virginia Polytechnic Institute and State University, Blacksburg, VA, June 1992.

D. P. Stinton, R. A. Lowden, and T. M. Besmann, *Fiber-Reinforced Composites for Gas Turbine Applications*, 92-GT-348, ASM International, Materials Park, OH, June 1992.

2.2.2 Open Literature Publications

S. L. Anderson, A. K. Datye, E. J. Braunschweig, and C. H. F. Peden, "Reactivity of Novel Ion-Exchanged Ni/Hydrous Titanate Catalysts," *Appl. Catal.* **A82**, 185 (1992).

J. L. Bates, L. A. Chick, and W. J. Weber, "Synthesis, Air Sintering, and Properties of Lanthanum and Yttrium Chromites and Manganites," *Solid State Ionics* **52**, 235-42 (1991).

T. M. Besmann, B. W. Sheldon, R. A. Lowden, and D. P. Stinton, "Vapor-Phase Fabrication and Properties of Continuous-Filament Ceramic Composites," *Science* **253**, 1104-9 (September 1991).

- C.-Y. Chu, J. P. Singh, and J. L. Routbort, "High Temperature Failure Mechanisms of Hot-Pressed Si_3N_4 and $\text{Si}_3\text{N}_4/\text{Si}_3\text{N}$ Whisker Reinforced Composites," *J. Am. Ceram. Soc.* (in press).
- B. Z. Egan, D. E. Fain, G. E. Roettger, D. E. White, "Separating Hydrogen from Coal Gasification Gases with Alumina Membranes," *J. Eng. Gas Turbines Power*, **114**, 367-370 (April 1992).
- D. E. Fain and G. E. Roettger, "Coal Gas Cleaning and Purification With Inorganic Membranes," *Trans. ASME*, in press (1993).
- T. J. Gardner, C. H. F. Peden, A. K. and Datye, "Activation Behavior of Ni/Hydrous Titanium Oxide (HTO) Catalysts," *Catal. Lett.* **15**, 111 (1992).
- F. D. Hardcastle, and C. H. F. Peden, "Molecular Structures of Titanates by Raman Spectroscopy: The FLS (Frequency/Length/Strength) Approach," *J. Phys. Chem.*, in press.
- F. D. Hardcastle, H. Klesnar, and C. H. F. Peden, "Structure Refinement of $\text{K}_2\text{Ti}_2\text{O}_5$ by Raman Spectroscopy and X-ray Powder Diffraction," *J. Solid State Chem.*, in press.
- F. D. Hardcastle, C. H. F. Peden, and K. B. Kidd, "Structure of Sodium Hydrous Titanates by Raman Spectroscopy," *Chem. Mater.*, in press.
- M. A. Janney, C. D. Calhoun, and H. D. Kimrey, "Microwave Sintering of Solid Oxide Fuel Cell Materials, I: Zirconia-8 mol% Ytria," *J. Am. Ceram. Soc.* **75**(2), 341-46 (1992).
- M. A. Janney and H. D. Kimrey, "Microwave Processing of Lanthanum Chromite," *J. Am. Ceram. Soc.*, in press.
- R. A. Lowden, K. L. More, O. J. Schwarz, "Improved Fiber Coatings for Nicalon®/SiC Composites," *Ceram. Eng. Sci. Proc.* **14** (in press).
- R. A. Lowden, K. L. More, and O. J. Schwarz, "Boron Nitride Interface Coatings for Nicalon®/SiC Composites," *J. Mater. Sci.* (in press).
- D. L. Mohr, P. Desai, and T. L. Starr, "Effect of Processing Parameters on Polysilazane Pre-ceramic Binders in a Ceramic Composite System," *Ceram. Eng. Sci. Proc.* **12**(9-10), 2095-104 (1991).
- C. H. F. Peden, B. C. Bunker, S. L. Martinez, F. W. Lytle, R. B. Greegor, and G. L. Turner, "Preparation and Characterization of Novel Catalyst Support Materials: The Hydrous Metal Oxide Ion-Exchangers," *Prepr. - Am. Chem. Soc., Div. Pet. Chem.* **36**, 443 (1991).
- B. H. Rabin and G. A. Moore, "Joining of SiC-Based Ceramics by Reaction Bonding Methods," *J. Mater. Synthesis Proc.* **1**, in press (1993).
- B. H. Rabin, "Joining of SiC Ceramics via Combustion Reactions," *Int. J. Self-Propagating High-Temperature Synthesis* **1**(1), 172-78 (1992).
-

B. H. Rabin, "Joining of Silicon Carbide/Silicon Carbide Dense Composites and Dense SiC Using Combustion Reactions in the Ti-C-Ni System," *J. Am. Ceram. Soc.* **75**(1), 131-35 (1992).

Y. G. Roman, D. P. Stinton, and T. M. Besmann, "Development of High Density Fiber Reinforced Silicon Carbide FCVI Composites," *Journal de Physique IV* **1**, C2-689 to C2-695 (September 1991).

S. Srinivasan, A. K. Datye, and C. H. F. Peden, "The Morphology of Supported MoS₂," *J. Catal.* (in press).

S. Srinivasan, A. K. Datye, M. J. Hampden-Smith, I. E. Wachs, G. Deo, J. M. Jehng, A. M. Turek, and C. H. F. Peden, "The Growth of Titanium Oxide Films on Silica Surfaces," *J. Catal.* **131**, 260 (1991).

T. L. Starr, A.W. Smith, and G.F. Vinyard, "Model-Assisted Control of Chemical Vapor Infiltration for Ceramic Composite Fabrication," *Ceram. Eng. Sci. Proc.* **12**(9-10), 2017-28 (1991).

T. L. Starr, "Advances in modeling of the chemical vapor infiltration process," *Mater. Res. Soc. Symp. Proc.* **250**, 207-14 (1991).

B. L. Weaver, R. A. Lowden, J. C. McLaughlin, D. P. Stinton, T. M. Besmann, and O. J. Schwarz, "Nextel™/SiC Composites Fabricated Using Forced Chemical Vapor Infiltration," *Ceram. Eng. Sci. Proc.* **14** (1993).

2.2.3 Papers in Conference Proceedings

J. L. Bates, L. A. Chick, J. J. Kingsley, L. R. Pederson, W. J. Weber, and G. E. Youngblood, et al., "Advanced Materials Development for Fossil Energy Conversion Applications," pp. 157-66 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

L. A. Chick, J. L. Bates, and G. D. Maupin, "Air-Sintering Mechanisms of Chromites," pp. 621-28 in *Proceedings of the Second International Symposium on Solid Oxide Fuel Cells*, Athens, Greece, ed. F. Grosz, P. Zegers, S. C. Singhal, and O. Yamamoto, Commission of the European Communities, Luxembourg, 1991.

L. A. Chick, L. R. Pederson, G. D. Maupin, and J. L. Bates, "Ultra-Fine Powders Using Glycine-Nitrate Combustion Synthesis," pp. 117-26 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

L. A. Chick, G. D. Maupin, and J. L. Bates, "Sintering of Complex Chromites," pp. 71-80 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

W. A. Ellingson, J. P. Singh, N. Gopalsami, S. L. Dieckman, A. S. Wagh, C.-Y. Chu, and T. Luethi, "Development of Nondestructive Evaluation Methods of Effects of Flaws on the Fracture Behavior of Structural Ceramics," pp. 137-53 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

W. A. Ellingson, J. P. Singh, D. L. Holloway, S. L. Dieckman, D. Singh, E. A. Sivers, S. H. Sheen, and M. J. Wheeler, "Development of Nondestructive Evaluation Methods and Prediction of Effects of Flaws on the Fracture Behavior of Structural Ceramics," pp. 119-30 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

W. A. Ellingson, M. W. Vannier, and D. P. Stinton, "Application of X-ray Computed Tomography to Ceramic/Ceramic Composites," pp. 9-25 in *Proceedings of the Characterization of Advanced Materials Symposium*, 20th Annual Meeting of the International Metallographic Society, Monterey, CA, July 27-28, 1987, ed. W. Altergott and E. Henneke, Plenum Press, New York, 1991.

W. A. Ellingson, N. Gopalsami, S. L. Dieckman, and T. Luethi, "Development of Nondestructive Characterization Technologies for Process Control of Ceramics," pp. 637-49 in *Proceedings of Iktetani Conference, the 5th International Symposium on Nondestructive Characterization of Materials*, Karuizawa, Japan, May 27 - June 3, 1991, Ketani Science and Technology Foundation, 1991.

D. E. Fain, G. E. Roettger, and D. E. White, "Development of Ceramic Membranes for High-Temperature Hydrogen Separation," pp. 55-64 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

D. E. Fain, G. E. Roettger, and D. E. White, "Ceramic Membranes for High Temperature Hydrogen Separation," pp. 167-77 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

G. B. Freeman, T. L. Starr, J. N. Harris, R. E. Kirchain, and D. L. Mohr, "Characterization of the Fiber-Matrix Interfaces in a SiC-Si₃N₄ Ceramic Composite System," pp. 299-306 in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

N. Gopalsami, S. L. Dieckman, W. A. Ellingson, R. E. Botto, and H. Yeh, "Quantitative MRI Measurement of Binder Distributions in Green-State Ceramics," pp. 1215-22 in *Proceedings of the 17th Annual Review of Progress in Quantitative NDE*, San Diego, CA, July 16-20, 1990, Vol. 10B, ed. D. O. Thompson and D. E. Chimenti, Plenum Press, New York, 1991.

M. A. Janney and H. D. Kimrey, "Microwave Sintering of Lanthanum Chromite," pp. 75-84 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

M. A. Janney, M. L. Jackson, and H. D. Kimrey, "Microwave Sintering of Ceria-Doped Zirconia," pp. 153-56 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

L. A. Lott, D. C. Kunerth, and G. W. Characklis, "Nondestructive Evaluation of Advanced Ceramic Composite Materials," pp. 155-61 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

R. A. Lowden, "Fiber Coatings and the Mechanical Properties of Continuous Fiber Reinforced Ceramic Matrix Composites," in *Proceedings of the Second European Colloquium: Designing Ceramic Interfaces*, Petten, The Netherlands, November 11-13, 1991, The Institute for Advanced Materials (in press).

R. A. Lowden and R. D. James, "Effects of Oxidizing and Combustion Environments on the Properties of Nicalon®/SiC Composites," pp. 33-46 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

R. A. Lowden and O. J. Schwarz, "Alternate Interface Coatings for Nicalon®/SiC Composites, Part I: Boron-Doped Carbon," pp. 93-106 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

A. Pechenik and G. Piermarini, "Fabrication of Transparent Ceramics from Clusters," pp. 179-92 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

C. H. F. Peden, "Ceramic Catalyst Materials: Hydrous Metal Oxide Ion-Exchange Supports for Direct Coal Liquefaction," p. 107 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

C. H. F. Peden, C. S. Ashley, D. H. Doughty, and T. J. Gardner, "Ceramic Catalyst Materials: Hydrous Metal Oxide Ion-Exchange Supports for Direct Coal Liquefaction," p. 81 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

B. H. Rabin and G. A. Moore, "Joining of SiC and SiC/SiC Composites," pp. 131-42 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

B. H. Rabin, "Joining of Fiber-Reinforced Silicon Carbide Composites," pp. 163-72 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

K. L. Reifsnider, W. W. Stinchcomb, and R. Osiroff, "Modeling of Creep Rupture Mechanisms in Composite Material Systems," pp. 51-58 in *Fracture and Damage*, proceedings of a symposium held at Anaheim, CA, November 8-13, 1992, AD-Vol. 27, ed. A. Nagar, American Society of Mechanical Engineers, New York, November 1992.

K. L. Reifsnider, W. W. Stinchcomb, and T. J. Dunyak, "Investigation of Properties and Performance of Ceramic Composite Components," pp. 127-36 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

K. L. Reifsnider, W. W. Stinchcomb, and T. J. Dunyak, "Investigation of Properties and Performance of Ceramic Composite Components," pp. 21-30 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

J. Sankar, A. D. Kelkar, and R. Vaidyanathan, "Mechanical Properties Testing of Ceramic Fiber-Ceramic Matrix Composites," pp. 85-95 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

J. Sankar, A. D. Kelkar, and R. Vaidyanathan, "Mechanical Properties Testing of Ceramic Fiber-Ceramic Matrix Composites," pp. 53-69 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

D. Singh and J. P. Singh, "Effect of Processing on Strength of Nicalon Fibers in Nicalon Fiber-SiC Matrix Composites," in *Proceedings of the 16th Annual Conference on Composites and Advanced Ceramic Materials*, Cocoa Beach, FL, January 7-10, 1992, American Ceramic Society, Westerville, OH; *Ceram. Eng. Sci. Proc.* 13(7-8), 257-66 (July-August 1992).

D. Singh and J. P. Singh, "Effect of High-Temperature Loading on Mechanical Properties of Nicalon Fibers and Nicalon Fiber/SiC Matrix Composites," in *Proceedings of the 17th Annual Conference on Composites and Advanced Ceramics*, Cocoa Beach, FL, January 11-15, 1993, The American Ceramic Society, Westerville, OH; *Ceram. Eng. Sci. Proc.* 14 (1993), to be published.

J. P. Singh, C.-Y. Chu, C. Murphy, and D. Singh, "Microstructural-Mechanical Properties Relationship and R-Curve Behavior in Si_3N_4 (w)/ Si_3N_4 Composites," pp. T962-T971 in *Advanced Materials; Meeting the Economic Challenge*, proceedings of the 24th International SAMPE Technical Conference, Toronto, Canada, October 20-22, 1992, ed. T. S. Reinhart, M. Rosenow, R. A. Cull, and E. Struckholt, Society for the Advancement of Material and Process Engineering, Convina, CA, October 1992.

T. L. Starr and A.W. Smith, "Modeling for Optimization and Control of CVI Fabrication of Ceramic Composites," pp. 13-23 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

T. L. Starr and A. W. Smith, "Three-Dimensional Model for CVI Fabrication of Disk and Tube Shaped Components," pp. 11-20 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

T. L. Starr, D. L. Mohr, J. A. Hanigofsky, and W. J. Lackey, "Development of Silicon Nitride Composites with Continuous Fiber Reinforcement," pp. 41-52 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

T. L. Starr, J. N. Harris, G. B. Freeman, and D. L. Mohr, "Reaction Sintered Silicon Nitride Composites with Continuous Fiber Reinforcement," pp. 47-53 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

D. P. Stinton, R. A. Lowden, and T. M. Besmann, "Fiber-Reinforced Tubular Composites by Chemical Vapor Infiltration," pp. 233-38 in *Chemical Vapor Deposition of Refractory Metals and Ceramics II*, Vol. 250, proceedings of a symposium held at San Francisco, CA, April 27 - May 1, 1992, ed. T. M. Besmann, B. M. Gallois, and J. W. Warren, Materials Research Society, Pittsburgh, 1992.

D. P. Stinton, R. A. Lowden, and T. M. Besmann, "Fiber-Reinforced Tubular Composites by Chemical Vapor Infiltration," pp. 3-10 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

D. P. Stinton, J. C. McLaughlin, and L. Riester, "Fiber-Reinforced SiC-Matrix Composites," pp. 3-12 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

K. R. Vaidyanathan, J. Sankar, A. D. Kelkar, D. P. Stinton, and M. H. Headinger, "Investigation of Mechanical Properties of Chemically Vapor Infiltrated Ceramic Matrix Composites," in *Proceedings of the 17th Annual Conference on Composites and Advanced Ceramics*, Cocoa Beach, FL, January 11-15, 1993, The American Ceramic Society, Westerville, OH; *Ceram. Eng. Sci. Proc.* **14** (1993), to be published.

D. M. Walukas, R. A. Lowden, and K. L. More, "Alternate Interface Coatings for Nicalon®/SiC Composites, Part II: Sol-Gel Oxides," pp. 107-18 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

B. L. Weaver, R. A. Lowden, J. C. McLaughlin, D. P. Stinton, T. M. Besmann, and O. J. Schwarz, "Nextel/SiC Composites Fabricated Using Forced Chemical Vapor Infiltration," in *Proceedings of the 17th Annual Conference on Composites and Advanced Ceramics*, Cocoa Beach, FL, January 11-15, 1993, The American Ceramic Society, Westerville, OH; *Ceram. Eng. Sci. Proc.* **14** (1993), to be published.

G. E. Youngblood, W. J. Weber, and J. L. Bates, "Electrochemical Processes: Solid Electrode-Electrolyte-Gas Interfaces," pp. 97-106 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

2.2.4 Books and Book Articles

L. A. Chick, G. D. Maupin, G. L. Graff, L. R. Pederson, D. E. McCready, and J. L. Bates, "Redox Effects in Self-Sustaining Combustion Synthesis of Oxide Ceramic Powders," pp. 159-64 in *Proceedings of the Materials Research Society 1991 Fall Meeting*, Boston, MA, December 2-6, 1991, Vol. 249, ed. W. E. Rhine, R. J. Gottschall, T. M. Shaw, and Y. Chen, Materials Research Society, Pittsburgh, 1992.

T. J. Dunyak, W. W. Stinchcomb, and K. L. Reifsnider, "Examination of Selected NDE Techniques for Ceramic Composite Components," pp. 3-24 in *Damage Detection in Composite Materials*, ASTM STP 1128, ed. J. E. Masters, American Society for Testing and Materials, Philadelphia, 1992.

N. Gopalsami, S. L. Dieckman, W. A. Ellingson, R. E. Botto, and H. Yeh, "Quantitative MRI Measurement of Binder Distributions in Green-State Ceramics," pp. 1215-22 in *Proceedings of the 17th Annual Review of Progress in Quantitative NDE*, San Diego, CA, July 16-20, 1990, Vol. 10B, ed. D. O. Thompson and D. E. Chimenti, Plenum Press, New York, 1991.

R. D. James, R. A. Lowden, and K. L. More, "The Effects of Oxidation and Corrosion on the Properties of Nicalon®/SiC Composites," pp. 925-35 in *Ceramic Transactions*, Vol. 19, Advanced Composite Materials, ed. by Michael D. Sacks, The American Ceramic Society, Westerville, OH, 1991.

M. A. Janney, H. D. Kimrey, and J. O. Kiggans, "Microwave Processing of Ceramics: Guidelines Used at the Oak Ridge National Laboratory," pp. 173-85 in *Microwave Processing of Materials III*, proceedings of a symposium held at San Francisco, CA, April 27 - May 1, 1992, ed. R. L. Beatty, W. H. Sutton, and M. F. Iskander, Materials Research Society, Pittsburgh, 1992.

J. J. Kingsley, L. A. Chick, G. W. Coffey, D. E. McCready, and L. R. Pederson, "Combustion Synthesis of Sr-Substituted $\text{LaCo}_{0.4}\text{Fe}_{0.6}\text{O}_3$ Powders," pp. 113-20 in *Better Ceramics Through Chemistry V*, ed. M. J. Hamden-Smith, W. G. Klemperer, and C. J. Brinker, Materials Research Society, Pittsburgh, 1992.

R. A. Lowden, "Fiber Coatings and the Mechanical Properties of a Fiber-Reinforced Ceramic Composite," pp. 619-30 in *Ceramic Transactions*, Vol. 19, Advanced Composite Materials, ed. Michael D. Sacks, The American Ceramic Society, Westerville, OH, 1991.

B. H. Rabin and G. A. Moore, "Reaction Bonding Methods for Joining SiC," to be published in *Joining and Adhesion of Advanced Inorganic Materials (Mater. Res. Soc. Symp. Proc.)*, Materials Research Society, Pittsburgh, 1993.

B. H. Rabin and G. A. Moore, "Joining of SiC Using Reaction Bonding Methods," to be published in *Joining of Structural Ceramics II, Ceramic Transactions*, American Ceramic Society, Westerville, OH, 1993.

D. P. Stinton, T. M. Besmann, R. A. Lowden, and B. W. Sheldon, "Vapor Deposition," pp. 215-22 in *Engineered Materials Handbook, Vol. 4, Ceramics and Glasses*, ed. S. J. Schneider, Jr., ASM International, Materials Park, OH, December 1991.

2.3 NEW ALLOYS

2.3.1 Topical Reports

D. I. Ash, G. R. Edwards, and S. A. David, *Weldability and Hot Ductility of Iron Aluminides*, ORNL/Sub/85-27421/04, Center for Welding and Joining Research, Colorado School of Mines, Golden, CO, May 1991.

A. A. Fasching, G. R. Edwards, and S. A. David, *Grain Growth Kinetics of Iron Aluminide Alloy FA-129*, ORNL/Sub/85-27421/05, Center for Welding and Joining Research, Colorado School of Mines, Golden, CO, February 1993.

P. D. Ferro, B. Yost, R. W. Swindeman, and Che-Yu Li, *Deformation and Thermal Fatigue in High-Temperature Austenitic Alloys*, ORNL/Sub/85-27488/05, Cornell University, Ithaca, NY, March 1991.

F. D. Geib and R. A. Rapp, *Simultaneous Chromizing-Aluminizing Coating of Low Alloy Steels by a Halide-Activated Pack Cementation Process*, ORNL/Sub/87-SB154/01, Ohio State Research Foundation, Columbus, OH, November 1992.

M. A. Harper and R. A. Rapp, *Codeposition of Chromium and Silicon onto Iron-Base Alloys via Pack Cementation*, ORNL/Sub/87-SB154/02, Ohio State Research Foundation, Columbus, OH, December 1992.

C. D. Lundin, C. Y. P. Qiao, Y. Kikuchi, C. Shi, and T. P. S. Gill, *Investigation of Joining Techniques for Advanced Austenitic Alloys*, ORNL/Sub/88-07685/02, University of Tennessee, Knoxville, TN, May 1991.

C. D. Lundin and C. Y. P. Qiao, *Evaluation of HAZ Liquation Cracking Susceptibility and HAZ Softening Behavior in Modified 800H*, ORNL/Sub/88-07685/03, University of Tennessee, Knoxville, TN, November 1992.

R. W. Swindeman, *The Potential of Modified Type 310 Stainless Steel for Advanced Fossil Energy Applications*, ORNL-TM-12057, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, March 1992.

Mark J. Topolski, *Evaluation of the Fabricability of Advanced Austenitic Tubing*, ORNL/Sub/88-SB775/02, Babcock & Wilcox, Alliance, OH, March 1991.

J. R. Weir, Jr., and V. K. Sikka, *Primary Fabrication Processes for Nickel and Iron Aluminides*, SAE Technical Paper No. 912194, SAE International, Warrendale, PA, 1991.

2.3.2 Open Literature Publications

A. Castagna and N. S. Stoloff, "The Influence of Environment on Fatigue Crack Growth of an Fe₃Al-Cr Alloy," *Scr. Metall.* **26**, 325-30 (March 1992).

M. A. Harper and R. A. Rapp, "Codeposited Chromium and Silicon Diffusion Coatings for Fe-Base Alloys Via Pack Cementation," *Oxid. Met.* (January 1993), in press.

J. R. Knibloe, R. N. Wright, C. L. Trybus, and V. K. Sikka, "Microstructure and Mechanical Properties of Fe₃Al Alloys with Chromium," *J. Mater. Sci.* **28** (1993), in press.

J. R. Knibloe, R. N. Wright, V. K. Sikka, R. H. Baldwin, and C. R. Howell, "Elevated Temperature Behavior of Fe₃Al with Cr Additions," *Mater. Sci. Eng.* **A153**, 382-86 (1992).

J. R. Knibloe, R. N. Wright, V. K. Sikka, R. H. Baldwin, and C. R. Howell, "Elevated Temperature Behavior of Fe₃Al with Chromium Additions," *Mater. Sci. Eng.* **A152**, 382-86 (1992).

M. C. Maguire, G. R. Edwards, and S. A. David, "Weldability and Hot Ductility of Chromium-Modified Ni₃Al Alloys," *Weld. J.* **71**(7), 231s-242s, July 1992.

P. J. Maziasz and C. G. McKamey, "Microstructural Characterization of Precipitates Formed During High-Temperature Testing and Processing of Iron-Aluminide Alloys," *Mater. Sci. Eng.* **A152**, 322-34 (1992).

C. G. McKamey, J. H. DeVan, P. F. Tortorelli, and V. K. Sikka, "A Review of Recent Developments on Fe₃Al-Based Alloys," *J. Mater. Res.* **6**(8), 1779-805 (1991).

C. G. McKamey, P. J. Maziasz, and P. W. Jones, "Effect of Addition of Molybdenum or Niobium on Creep Rupture Properties of Fe₃Al," *J. Mater. Res.* **7**(8), 2089-106 (1992).

K. Natesan, "Applications of Coatings in Coal-Fired Energy Systems," *Surf. Coat. Technol.* (March 1993), in press.

P. G. Sanders, V. K. Sikka, C. R. Howell, and R. H. Baldwin, "A Processing Method to Reduce Environmental Embrittlement in Fe₃Al-Based Alloys," *Scr. Metall.* 25, 2365-69 (1991).

V. K. Sikka and R. H. Baldwin, "Creep-Rupture Properties of Fe₃Al-Based Iron-Aluminide Alloys," *SAMPE Q.* 24(1), 2-9 (1992).

V. K. Sikka, "Ductility Enhancement of Iron-Aluminide Alloys," *SAMPE Q.* 22(4), 2-10 (1991).

S. Vyas, S. Viswanathan, and V. K. Sikka, "Effect of Aluminum Content on Environmental Embrittlement in Binary Iron-Aluminum Alloys," *Scr. Metall.* 27, 185-90 (1992).

J. K. Wright, R. N. Wright, and G. A. Moore, "Combustion Synthesized Iron Aluminide Coatings and Joints," *Scr. Metall. Mater.* 28(4), 501-6 (February 1993).

2.3.3 Papers in Conference Proceedings

D. J. Alexander and V. K. Sikka, "Fracture Behavior of Iron Aluminides," pp. 295-304 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

D. J. Alexander and V. K. Sikka, "Fracture Behavior of Fe₃Al Alloy FA-129," pp. 239-48 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

A. Castagna and N. S. Stoloff, "Investigation of Moisture-Induced Embrittlement of Iron Aluminides," pp. 249-59 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

A. Castagna and N. S. Stoloff, "Investigation of Moisture-Induced Embrittlement of Iron Aluminides," pp. 305-14 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ed. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

D. I. Ash, A. A. Fasching, G. R. Edwards, and S. A. David, "Investigation of the Weldability of Polycrystalline Iron Aluminides," pp. 209-17 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

H. D. Brody and L. L. Rishel, "Melting, Casting, and Solidification Behavior of Iron Aluminides," pp. 187-96 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

A. A. Fasching, G. R. Edwards, and S. A. David, "Weldability of Polycrystalline Aluminides", pp. 247-56 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

F. D. Geib and R. A. Rapp, "Diffusion Coatings for Iron Aluminide Fe₃Al by Halide-Activated Pack Cementation," The Metallurgical Society, Warrendale, PA, October 1991.

M. A. Harper and R. A. Rapp, "Chromized/Siliconized Pack Cementation Diffusion Coatings for Heat Resistant Alloys," in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

M. A. Harper, M. Zhu, and R. A. Rapp, "Pack Cementation Diffusion Coatings for Iron-Base Alloys: Codeposition of Chromium and Silicon," pp. 265-69 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

M. A. Harper, F. D. Geib, and R. A. Rapp, "Pack Cementation Diffusion Coatings for Fe-Base Alloys," pp. 289-99 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

M. A. Harper and R. A. Rapp, "Chromized/Siliconized Diffusion Coatings for Iron-Base Alloys by Pack Cementation," in *Materials Performance*, Cincinnati, OH, National Association of Corrosion Engineers, Houston, TX, September 1991.

R. N. Johnson, "Electro-Spark Deposited Coatings for Protection of Materials in Sulfidizing Atmospheres," pp. 281-88 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

R. N. Johnson, "Electro-Spark Deposited Coatings for Fossil Energy Environments," pp. 257-64 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

J. R. Knibloe and R. N. Wright, "The Influence of Thermomechanical Processing on Microstructure and Properties of Iron Aluminides," pp. 207-15 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

Che-Yu Li, "Deformation and Thermal Fatigue in High-Temperature Austenitic Alloys," pp. 345-52 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

C. T. Liu, "Development of Cr₂Nb Intermetallic Alloys for High-Temperature Structural Use," pp. 375-83 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

C. D. Lundin and C. Y. P. Qiao, "HAZ Characterization in Modified 316 Stainless Steels," pp. 333-44 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

C. D. Lundin, C. Y. P. Qiao, and Y. Kikuchi, "Intergranular Liquation Cracking in an Advanced Austenitic Stainless Steel," pp. 71-79 in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

C. D. Lundin, C. Y. P. Qiao, and C. Shi, "Investigation of the Weldability of Modified 800H Alloys," *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

C. G. McKamey, T. Zacharia, and P. J. Maziasz, "Development of Weldable High-Strength Iron Aluminides," pp. 237-46 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

C. G. McKamey and P. J. Maziasz, "Alloy Development of Fe₃Al for Improved Creep Rupture Properties," pp. 175-85 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

C. G. McKamey and C. T. Liu, "Environmental Embrittlement of Iron Aluminides in Moisture-Containing Atmospheres," paper 17 in *Proceedings of ADVMAT/91, First International Symposium on Environmental Effects on Advanced Materials*, ed. R. D. Kane, National Association of Corrosion Engineers, Houston, TX, 1992.

W. R. Mohn and M. J. Topolski, "Evaluation of the Fabricability of Advanced Iron Aluminide-Clad Austenitic Stainless Steel Tubing," pp. 337-43 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

V. K. Sikka, "Production of Fe₃Al-Based Intermetallic Alloys," pp. 907-12 in *High Temperature Ordered Intermetallics IV*, proceedings of a symposium held in Boston, MA, November 26 - December 1, 1990, Vol. 213, ed. L. A. Johnson, D. P. Pope, and J. O. Stiegler, Materials Research Society, Pittsburgh, 1991.

V. K. Sikka, R. H. Baldwin, K. S. Blakely, E. C. Hatfield, C. R. Howell, and C. G. McKamey, "Preparation and Fabrication of Iron Aluminides," pp. 197-207 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

V. K. Sikka, "Development of Nickel and Iron Aluminides and Their Applications," to be published in *Proceedings of the 30th Annual CIM Conference of Metallurgists International Symposium on Advances in Gas Turbine Engine Materials*, Canadian Institute of Mining, Metallurgy and Petroleum, Montreal, Quebec, Canada, 1991.

V. K. Sikka, R. H. Baldwin, J. H. Reinshagen, J. R. Knibloe, and R. N. Wright, "Powder Processing of Fe₃Al-Based Iron Aluminide Alloys," pp. 901-6 in *High Temperature Ordered Intermetallics IV*, proceedings of a symposium held in Boston, MA, November 26 - December 1, 1990, Vol. 213, ed. L. A. Johnson, D. P. Pope, and J. O. Stiegler, Materials Research Society, Pittsburgh, 1991.

V. K. Sikka and S. Viswanathan, "Fabrication and Processing of Iron Aluminides," pp. 195-206 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

R. W. Swindeman, "Creep Response of a 9Cr-1Mo-V-Nb Steel to Varying Stresses and Temperatures," pp. 900-13 in *Proceedings of the International Conference on Pressure Vessel Technology 7*, Dusseldorf, Germany, 1992.

R. W. Swindeman and P. J. Maziasz, "The Effect of MC Forming Additions and 10% Cold Work on High Temperature Strength of 20Cr-30Ni-Fe Alloys," pp. 251-60 in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

R. W. Swindeman, "Evaluation of Austenitic Alloys for Advanced Steam Cycles and Hot-Gas Cleanup Systems," pp. 327-35 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

R. W. Swindeman, "Investigation of Austenitic Alloys for Advanced Heat Recovery and Hot-Gas Cleanup Systems," pp. 311-21 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

M. J. Topolski, "Fabrication of Advanced Austenitic Alloy Superheater Tubing," pp. 223-32 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

S. Viswanathan, P. J. Maziasz, and V. K. Sikka, "Solidification of FA-129 Iron-Aluminide Alloy," pp. 283-93 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

R. N. Wright, "Microstructure and Properties of Iron Aluminides," in *Proceedings of the Canadian Institute of Metallurgists Symposium on High Temperature Materials*, Ottawa Canada, 1992.

R. N. Wright and J. R. Knibloe, "The Influence of Thermomechanical Processing on the Structure and Properties of Iron Aluminides," pp. 219-28 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

T. Zacharia and S. A. David, "Weldability of Iron Aluminides," pp. 229-37 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

T. Zacharia, P. J. Maziasz, S. A. David, and C. G. McKamey, "Weldability of Fe₃Al-Based Iron Aluminide Alloys," pp. 227-35 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

2.3.4 Books and Book Articles

A. Castagna and N. S. Stoloff, "The Influence of Environment on Fatigue Crack Growth of an Fe₃Al,Cr Alloy," pp. 689-99 in *Properties and Applications of Metallic and Ceramic Materials VII*, ed. M. H. Loretto, MCE Publishers, Ltd., Birmingham, England.

C. D. Lundin, C. Y. P. Qiao, and R.W. Swindeman, "Microstructural Investigation of the Heat-Affected Zones in Newly Developed Advanced Austenitic Stainless Steels," pp. 751-70 in *Microstructural Science*, Vol. 19, December 1992.

V. K. Sikka, B. G. Gieseke, and R. H. Baldwin, "Mechanical Properties of Fe₃Al-Based Alloys," pp. 363-71 in *Heat-Resistant Materials*, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

V. K. Sikka, "Processing and Fabrication of Fe₃Al-Based Alloys," pp. 141-47 in *Heat-Resistant Materials*, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

V. K. Sikka, R. H. Baldwin, C. R. Howell, and J. H. Reinshagen, "P/M Processing and Applications of Fe₃Al-Based Intermetallics," pp. 147-58 in *Advances in Powder Metallurgy - 1991*, Vol. 6, ed. Leander F. Pease, III, and Reynald J. Sansoucy, Metal Powder Industries Federation and American Powder Metallurgy Institute, Princeton, NJ, 1991.

N. S. Stoloff, "Cyclic Deformation of Intermetallic Alloys", pp. 257-77 in *Ordered Intermetallics - Physical Metallurgy and Mechanical Behavior*, ed. C. T. Liu, R. W. Cahn, and G. Sauthoff, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1992.

2.4 CORROSION AND EROSION RESEARCH

2.4.1 Topical Reports

R. A. Buchanan and J. G. Kim, *Aqueous Corrosion Characteristics and Corrosion-Related Cracking Susceptibilities of Fe₃Al-Type Iron Aluminides*, ORNL/Sub/88-07685CT92/01, University of Tennessee, Knoxville, TN, April 1991.

R. A. Buchanan and J. G. Kim, *Fe₃Al-Type Iron Aluminides: Aqueous Corrosion Properties in a Range of Electrolytes and Slow-Strain-Rate Ductilities During Aqueous Corrosion*, ORNL/Sub/88-07685CT92/02, University of Tennessee, Knoxville, TN, August 1992.

L. K. Ives, *Abrasive Wear by Coal-Fueled Diesel Engine and Related Particles*, ORNL/Sub/83-21322/02, National Institute of Standards and Technology, Gaithersburg, MD, September 1992.

T. H. Kosel, *A Study of Erosive Particle Rebound Parameters*, ORNL/Sub/86-91346/02, University of Notre Dame, South Bend, IN, April 1992.

J. H. Park and K. Natesan, *Electronic Transport Properties in Copper Oxides*, ANL-91/27, Argonne National Laboratory, Argonne, IL, 1991.

J. H. Park and K. Natesan, *Oxidation Behavior of Iron-Chromium Alloys at Elevated Temperatures: A Reactive-Element Effect*, ANL/FE-92/1, Argonne National Laboratory, Argonne, IL, March 1992.

M. Rao and J. R. Keiser, *Studies of Near-Surface Phenomena and Erosion Mechanisms in Metallic Alloys Using Single- and Multiple-Particle Impacts*, ORNL/TM-11946, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, March 1992.

W. Tabakoff, A. Hamed, M. Metwally, and J. Yeuan, *Study of Particle Rebound Characteristics and Material Erosion at High Temperatures*, ORNL/Sub/84-89628/04, University of Cincinnati, Cincinnati, OH, April 1992.

S. Van Weele and J. L. Blough, *Fireside Corrosion Testing of Candidate Superheater Tube Alloys, Coatings, and Claddings*, ORNL/Sub/89-SA187/02, Foster Wheeler Development Corporation, Livingston, NJ, August 1991.

2.4.2 Open Literature Publications

J. R. Keiser and M. Rao, "Response of Aluminum Alloys to Particle Impacts," *Mater. Perform.* 30(2), 80-84 (February 1991).

K. Natesan, "Materials Performance in Advanced Fossil Technologies," *J. Met.* 43(11), 61 (November 1991).

J. H. Park, K. Natesan, and D. L. Rink, "Sulfur and Oxygen Transport Properties of Thermally Grown Cr₂O₃ Films," *High Temp. Sci.* 30, 193 (1991).

W. Tabakoff, "High Temperature Erosion Resistance of Coatings for Use in Gas Turbine Engines," *Surf. Coat. Technol.* 52, 65-79 (April 1992).

W. Tabakoff, "Measurement of Particle Rebound Characteristics on Materials Used in Gas Turbines," *AIAA J. Propul. Power* 7(5), 805-13 (September/October 1991).

W. Tabakoff, "Turbomachinery Alloys Affected by Solid Particles," *Int. J. Turbo Jet Engines* 7, 207-15 (1991).

W. Tabakoff, A. Hamed, M. Metwally, and M. Pasin, "High-Temperature Erosion Resistance of Coatings for Gas Turbines," *J. Eng. Gas Turbines Power* 114, 242-49 (April 1992).

W. Tabakoff, A. Hamed, and M. Metwally, "Effect of Particle Size Distribution on Particle Dynamics and Blade Erosion in Axial Flow Turbines," *J. Eng. Gas Turbines Power* 113, 607-15 (October 1991).

W. Tabakoff and M. Metwally, "Coating Effect on Particle Trajectories and Turbine Blade Erosion," *J. Eng. Gas Turbines Power* 114, 250-57 (April 1992).

P. F. Tortorelli and J. H. DeVan, "Behavior of Iron Aluminides in Oxidizing and Oxidizing/Sulfidizing Environments," *Mater. Sci. Eng.* A153, 573-77 (1992) [ORNL].

P. F. Tortorelli and J. R. Keiser, "The Use of Depth-Sensing Submicron Indentation Testing to Characterize the Mechanical Behavior of Thin Oxide Scales," *Scr. Metall. Mater.* 25, 2339-44 (1991) [ORNL].

2.4.3 Papers in Conference Proceedings

J. L. Blough and S. Van Weele, "Fireside Corrosion Testing of Candidate Superheater Tube Alloys, Coatings, and Claddings," pp. 301-10 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991 [FW].

R. A. Buchanan and J. G. Kim, "Fe₃Al-Type Iron Aluminides: Aqueous Corrosion Properties in a Range of Electrolytes and Slow-Strain-Rate Ductilities During Aqueous Corrosion," pp. 315-23 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992 [UT].

R. A. Buchanan and J. G. Kim, "Ductilities of Iron Aluminides Under Slow-Strain-Rate Corrosion Conditions With and Without Hydrogen Charging," pp. 271-79 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991 [UT].

J. H. DeVan, "Environmental Effects on Iron Aluminides," pp. 261-70 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991 [ORNL].

J. H. DeVan, P. F. Tortorelli, and U. K. Abdali, "Environmental Effects on Iron Aluminides," pp. 217-26 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992 [ORNL].

L. K. Ives, "Wear by Coal-Fueled Diesel Combustion Particulates," pp. 367-76 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

T. H. Kosel, "Comparisons of Observed and Predicted Rebound Velocities of Erodent Particles," pp. 415-26 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

A. V. Levy, B. Q. Wang, and G. Q. Geng, "The Wastage of Steels in the Erosion-Corrosion of Fluidized-Bed Combustors," pp. 389-402 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

K. Natesan, "Coatings for Improved Corrosion Resistance," *Proceedings of the 3rd International Conference on Advances in Coatings and Surface Engineering for Corrosion and Wear Resistance*, New Castle, U.K., May 11-15, 1992.

K. Natesan, "Corrosion Performance of Oxide-Dispersion-Strengthened Fe-Cr-Ni-Al Alloys in Coal Conversion Atmospheres," pp. 355-66 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

K. Natesan, "Corrosion Resistance of Iron Aluminides," pp. 271-82 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

K. Natesan, "Corrosion Assessment in FBC Systems," p. 3-1 in *Proceedings of the 4th Berkeley Conference on Corrosion-Erosion-Wear of Materials at Elevated Temperature*, Berkeley, CA, January 31 - February 2, 1990, ed. A. V. Levy, Lawrence Berkeley Laboratory, 1991.

K. Natesan and W. F. Podolski, "Materials for FBC Cogeneration Systems," p. 549 in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

K. Natesan and J. H. Park, "Oxidation/Sulfidation Behavior of Fe-Cr Alloys: A Reactive-Element Effect," pp. 357-66 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

K. Natesan and D. Y. Wang, "Development of Weldments for Sulfur-Containing Combustion Environments," p. 395 in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

K. Natesan and W. F. Podolski, "Materials Performance in Fluidized-Bed Air Heaters," paper 125 in *CORROSION 92, Proceedings of the NACE Annual Conference and Corrosion Show*, Nashville, TN, April 27, 1992, National Association of Corrosion Engineers, Houston, TX, 1992.

J. H. Park and K. Natesan, "Transport Properties of Chromium and Fe-Cr Alloys Exposed to Oxygen-Sulfur Environments," p. 36 in *Proceedings of the 4th Berkeley Conference on Corrosion-Erosion-Wear of Materials at Elevated Temperature*, Berkeley, CA, January 31 - February 2, 1990, ed. A. V. Levy, Lawrence Berkeley Laboratory, 1991.

J. H. Park and K. Natesan, "Oxidation/Sulfidation of Fe-Cr Alloys; A Reactive Element Effect," p. 357 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

J. H. Park and K. Natesan, "Transport Properties and Oxidation in Chromium and Fe-Cr Alloys Exposed to Oxygen at High Temperatures," p. 219 in *Heat-Resistant Materials: Proceedings of the First International Conference*, Lake Geneva, WI, September 22-26, 1991, ed. K. Natesan and D. J. Tillack, ASM International, Materials Park, OH, 1991.

M. Rao and J. R. Keiser, "Erosion Studies in Fe₃Al-Based Iron Aluminide and 1100 Al," pp. 427-38 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

W. Tabakoff, A. Hamed, and M. Metwally, "Particle Rebound Characteristics and Material Erosion at High Temperature," pp. 403-14 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

W. Tabakoff and M. Metwally, "Coating Effect on Particle Trajectories and Turbine Blade Erosion," pp. 215-23 in *Proceedings of the Fifth International Symposium on Gas Turbines*, September 3-5, 1991, Budapest, Hungary, International Gas Turbine Institute, 1991.

P. F. Tortorelli and J. H. DeVan, "The Nature of Scales Grown on Binary Cr-Nb Alloys," pp. 229-36 in *Proceedings of the Symposium on Oxide Films on Metals and Alloys*, Toronto, Canada, October 12-16, 1992, Vol. 92-22, ed. B. R. MacDougall, R. S. Alwitt, and T. A. Ramanarayanan, The Electrochemical Society, Pennington, NJ, 1992.

P. F. Tortorelli and J. H. DeVan, "High-Temperature Oxidation of Cr-Cr₂Nb Alloys," pp. 385-94 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

P. F. Tortorelli, J. H. DeVan, and U. K. Abdali, "Cyclic Oxidation of Iron Aluminides," paper 258 in *CORROSION 93, Proceedings of the NACE Annual Conference and Corrosion Show*, New Orleans, LA, March 8-12, 1993, National Association of Corrosion Engineers, Houston, TX, March 1993.

P. F. Tortorelli and J. R. Keiser, "The Mechanical Properties of Oxides Scales," pp. 377-87 in *Proceedings of the Fifth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 14-16, 1991, ORNL/FMP-91/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, September 1991.

P. F. Tortorelli, J. R. Keiser, K. R. Willson, and W. C. Oliver, "Effects of Reactive Elements on Oxide Scale Deformation and Cracking Based on Submicron Indentation Testing," pp. 271-77 in *Microscopy of Oxidation*, Cambridge, England, March 26-28, 1990, ed. M. J. Bennett and G. W. Lorimer, The Institute of Metals, London, 1991.

S. Van Weele and J. L. Blough, "Attack of Superheater Tube Alloys, Coatings, and Claddings by Coal-Ash Corrosion," pp. 367-74 in *Proceedings of the Sixth Annual Conference on Fossil Energy Materials*, Oak Ridge, TN, May 12-14, 1992, ORNL/FMP-92/1, comp. N. C. Cole and R. R. Judkins, Oak Ridge National Laboratory, July 1992.

2.4.4 Books and Book Articles

R. A. Buchanan and J. G. Kim, "Chloride-Induced Localized Corrosion of Fe₃Al-Type Iron Aluminides," pp. 945-50 in *High-Temperature Ordered Intermetallic Alloys IV*, ed. L. A. Johnson, D. P. Pope, and J. O. Stiegler, Materials Research Society, Pittsburgh, 1991.

N. C. Cole and R. R. Judkins, "Overview of the Department of Energy-Fossil Energy Advanced Research and Technology Development Materials Program Regarding Corrosion Issues," paper 143 in *CORROSION 92, Proceedings of the NACE Annual Conference and Corrosion Show*, Nashville, TN, April 27, 1992, National Association of Corrosion Engineers, Houston, TX, 1992.

J. R. Keiser and R. R. Judkins, "Chlorine Related Degradation of Materials in Coal Liquefaction," pp. 109-27 in *Chlorine in Coal*, ed. J. Stringer and D. D. Banerjee, Elsevier Science Publishers, New York, 1991.

3. ENVIRONMENTAL, HEALTH, AND SAFETY ACTIVITIES

3.1 ENVIRONMENTAL ANALYSIS

3.1.1 Topical Reports

N. E. Korte, C. A. Muhr, and D. W. Greene, *Potential Levels of Polychlorinated Dibenzodioxin and Dibenzofuran Contamination as a Result of Polychlorinated Biphenyl Use in Heat Transfer Operations*, ORNL/TM-11730, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, April 1992.

L. N. McCold et al., *Environmental Assessment, Combustion Engineering, Integrated Coal Gasification Combined Cycle Repowering Project*, DOE/EA-0444, U.S. Department of Energy, Washington, D.C., March 1992.

R. L. Miller et al., *Draft Environmental Impact Statement for the Proposed Healy Clean Coal Project*, DOE/EIS-0186, U.S. Department of Energy, Washington, D.C., November 1992.

R. L. Siegrist, N. E. Korte, D. Pickering, T. Phelps, *Preliminary Characterization of the Power Plant Burn Pit on Roi-Namur Island, Kwajalein Atoll, Republic of the Marshall Islands*, ORNL/TM-1821, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory.

3.1.2 Open Literature Publications

R. R. Judkins, W. Fulkerson, and M. K. Sanghvi, "The Dilemma of Fossil Fuel Use and Global Climate Change," *Energy and Fuels* 7 (1), 14-22 (January 1993).

P. M. Kearl, N. E. Korte, and T. A. Cronk, "Suggested Modifications to Groundwater Sampling Procedures Based on Observations from the Colloidal Borescope," *Ground Water Monit. Rev.* 12(2), 155 (1992).

P. M. Kearl, N. E. Korte, T. A. Gleason, and J. S. Beale, "Vapor Extraction Experiments with Laboratory Soil Columns: Implications for Field Programs," *Waste Manage.* 11(4), 231 (1991).

N. E. Korte, "Naturally-Occurring Arsenic in Groundwater of the Midwestern United States," *Environ. Geol. Water Sci.* 18(2), 137 (September 1991).

N. E. Korte and D. Brown, "Referee Analyses - A Better Approach Than Data Validation," *Environ. Manage.* (in press).

N. E. Korte and Q. Fernando, "A Review of Arsenic-III in Groundwater," *Crit. Rev. Environ. Control* 21(1), 1.

N. E. Korte, P. M. Kearl, T. A. Gleason, and J. S. Beale, "The Inadequacy of Commonly Used Risk Assessment Guidance for Determining Whether Solvent-Contaminated Soils Can Affect Groundwater at Arid Sites," *J. Environ. Sci. Health A27*(8), 2251-61 (December 1992).

N. E. Korte, S. Wagner, and J. Nyquist, "Choosing an appropriate Soil-Gas Survey Method," *Environ. Monit. Assess.* **21**, 27-35 (April 1992).

3.1.3 Papers in Conference Proceedings

T. J. Blasing, "Potential Contribution of Clean Coal Technologies to Reducing Global Emissions of Greenhouse Gases," in *Proceedings, 85th Annual Meeting & Exhibition*, Kansas City, MO, June 21-26, 1992, Air & Waste Management Association, 1992.

D. E. Brown and N. E. Korte, "Environmental Restoration at the Kansas City Plant Quality Science with a View Toward the Future," in *Proceedings of the International Topical Meeting on Nuclear and Hazardous Waste Management Spectrum '92*, Boise, ID, August 23-27, 1992, American Nuclear Society, Inc., LaGrange Park, IL, 1992.

K. Dickerson, N. E. Korte, "Integrating State-of-the Science Technology for a Cost-Effective Site Characterization at the Kansas City Plant," in *TIE Quarterly*, Albuquerque, NM, May 18-19, 1992, Management Systems Laboratories of Virginia Tech, Blacksburg, VA, 1992.

N. E. Korte, "Need for Data Validation," in *TIE Quarterly*, Augusta, GA, November 18-20, 1991, Management Systems Laboratories of Virginia Tech, Blacksburg, VA, 1992.

N. E. Korte, "Soil-gas surveys may be oversold in defining subsurface contamination," in *TIE Quarterly*, Augusta, GA, November 18-20, 1991, Management Systems Laboratories of Virginia Tech, Blacksburg, VA, 1992.

N. E. Korte, "Large-Scale Restoration of Western Watersheds - Should it be Public Policy?," in *Beauty in Science, Proceedings of the Southwestern and Rocky Mountain Division, American Association for the Advancement of Science Sixty-Eighth Annual Meeting (Eighth Tucson Meeting)*, Tucson, AZ, May 17-May 21, 1992, ed. M. Michelle Balcomb, Southwestern and Rocky Mountain Division, American Association for the Advancement of Science, Glenwood Springs, CO, May 1992.

N. E. Korte and P. Kearl, "Data Validation and Risk Assessment - Some Pitfalls When Evaluating VOC Measurements," in *Measuring and Interpreting VOCs in Soils: State of the Art and Research Needs*, Las Vegas, NV, January 12-14, 1993, The Wisconsin Center, Madison, WI, January 1993.

N. E. Korte, P. M. Kearl, and D. Koehler, "Strategies to Define and Implement Large-Scale Watershed Restoration Policy on the Navajo Nation," in *Riparian Management: Common Threads and Shared Interests*, Albuquerque, NM, February 4-6, 1993, Water Resources Research Center, Tucson, AZ, February 1992.

N. E. Korte and J. E. Thate, "Health and Safety at Hazardous Waste Sites: Can We Be Too Careful?" in *205th American Chemical Society Meeting*, Denver, CO, March 29 - April 2, 1993, American Chemical Society, Washington, D.C., 1993.

R. L. Miller, "The Clean Coal Program's Contributions to Addressing the Requirements of the Clean Air Act Amendments of 1990," in *Proceedings, 85th Annual Meeting & Exhibition*, Kansas City, MO, June 21-26, 1992, Air & Waste Management Association, 1992.

3.1.4 Books and Book Articles

W. Fulkerson, R. R. Judkins, and M. K. Sanghvi, "Energy from Fossil Fuels," pp. 83-94 in *Energy for Planet Earth*, W. H. Freeman and Company, New York.

N. E. Korte, "Environmental Pollution Control," in *Hazardous Materials Management*, ed. H. T. Carson and D. B. Cox, Institute of Hazardous Materials Management, Rockville, MD, 1992.

4. COAL CONVERSION RESEARCH

4.1 BIOPROCESSING OF COAL

4.1.1 Open Literature Publications

M. Asif, J. N. Petersen, T. C. Scott, and J. M. Cosgrove, "Hydrodynamic Studies of an Advanced Fluidized-Bed Bioreactor for Direct Coal Liquefaction," *Appl. Biochem. Biotechnol.* (in press).

B. D. Faison, "Microbial Conversions of Low Rank Coals," *Biotechnology* 9, 951-56 (October 1991).

B. D. Faison, "Biological Coal Conversions," *Crit. Rev. Biotechnol.* 11(4), 346-66 (1991).

C. D. Scott, T. C. Scott, and C. A. Woodward, "The Chemical Modification of Enzymes to Enhance Solubilization in Organic Solvents for Interaction with Coal," *Fuel* (in press).

C. D. Scott, T. C. Scott, and C. A. Woodward, "Use of Dinitrofluorobenzene to Modify Enzymes for Enhanced Solubilization and Activity in Organic Solvents," *Appl. Biochem. Biotechnol.* (in press).

T. C. Scott, J. M. Cosgrove, M. Asif, and J. N. Petersen, "Hydrodynamic Studies of an Advanced Fluidized-Bed Bioreactor for Direct Interaction with Coal," *Fuel* (in press).

4.1.2 Papers in Conference Proceedings

C. D. Scott, B. D. Faison, C. A. Woodward, and R. R. Brunson, "Anaerobic Solubilization of Coal by Microorganisms and Isolated Enzymes," pp. 4-29 to 4-46 in *Proceedings of the Second International Symposium on the Biological Processing of Coal*, 1991.

4.1.3 Books and Book Articles

B. D. Faison, "The Chemistry of Low Rank Coals and Its Relationship to the Biochemical Mechanisms of Coal Biotransformation," pp. 1-26 in *Microbial Transformations of Low Rank Coals*.

C. D. Scott and S. N. Lewis, "Solubilization of Coal by Microbial Action," pp. 275-92 in *Bioprocessing and Biotreatment of Coal*, ed. Donald L. Wise, Marcel Dekker, Inc., New York, 1991.

5. COAL COMBUSTION RESEARCH

5.1 COMBUSTION TECHNOLOGY

5.1.1 Open Literature Publications

C. S. Daw, "Seeking Order from Chaos," *Oak Ridge Natl. Lab. Rev.* (June 1992).

R. P. Krishnan et al., "Evaluation of Freeboard Performance in a Fluidized Bed Combustor," *Fuel* 70 (October 1991).

5.1.2 Papers in Conference Proceedings

R. M. Wagner, C. S. Daw, and J. F. Thomas, "Controlling Chaos in Spark-Ignition Engines," in *Proceedings of Central and Eastern States Section Joint Technical Meeting of the Combustion Institute*, New Orleans, March 15-17, 1993 (in press).

C. S. Daw, J. F. Thomas, and G. A. Richards, "Modeling Deterministic Chaos in Thermal Pulse Combustion," in *Proceedings of the Central States Section of the Combustion Institute*, Columbus, Ohio, April 27-28, 1992, Combustion Institute, Pittsburgh, 1992.

5.1.3 Books and Book Articles

C. S. Daw and J. S. Halow, "Modeling Deterministic Chaos in Fluidized Beds," *AIChE Symposium Series, Fluidized Processes: Theory and Practice*, Vol. 88, ed. A. Weimer, American Institute of Chemical Engineers, New York, 1993.

6. FOSSIL FUELS SUPPLIES MODELING

6.1 STRATEGIC PETROLEUM RESERVE

6.1.1 Topical Reports

D. A. Trumble and R. M. Lee, *Benefits of Alternative Drawdown and Distribution Capabilities for the Strategic Petroleum Reserve: Results Under Revised Base Case Scenarios*, October 1991.

S.-P. Miaou, *Modeling Strategic Petroleum Reserve Crude Oil With Oil Trade Model*, January 1992.

7. COAL CHEMISTRY AND STRUCTURE

7.1 Papers in Conference Proceedings

E. L. Fuller, "Chemistry and Structure of Coals: Oxidation and Water Sorption Studies Using Diffuse Reflectance Infrared Spectroscopy, in *Proceedings of the 20th Biennial Conference on Carbon*, Santa Barbara, CA, June 23-28, 1991, 1992.

E. L. Fuller, "Chemistry and Structure of coals: Systematic Evaluation of Surface Area and Porosity from Physisorption Isotherms," in *Proceedings of the 20th Biennial Conference on Carbon*, Santa Barbara, CA, June 23-28, 1991, 1992.

E. L. Fuller, "Evaluation of Surface Structure and Chemistry of Coal, Chars and Graphites," in *Proceedings of the 66th Colloid and Surface Science Symposium*, Morgantown, WV, June 14-17, 1992 (in press).

E. L. Fuller, "Gravimetric Measurements of the Kinetics and Mechanisms of Air Oxidation of Commercial Graphites," in *CARBON '92*, proceedings of the International Conference on Carbon, Essen, Germany, June 22-26, 1992 (in press).

E. L. Fuller, "Chemistry and Structure of Coals: Spectroscopic Evaluation of Hydrogenous Species, in *CARBON '92*, proceedings of the International Conference on Carbon, Essen, Germany, June 22-26, 1992 (in press).

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