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Publications of the Oak Ridge National Laboratory Fossil Energy Program and the AR&TD Materials Program

April 1, 1995, through March 31, 1997

Compiled by

Paul T. Carlson

Fossil Energy Program Office

OAK RIDGE NATIONAL LABORATORY
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LOCKHEED MARTIN ENERGY RESEARCH CORP.
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U.S. DEPARTMENT OF ENERGY
FOSSIL ENERGY

PUBLICATIONS

OF THE

OAK RIDGE NATIONAL LABORATORY
FOSSIL ENERGY PROGRAM

AND THE

AR&TD MATERIALS PROGRAM

April 1, 1995, through March 31, 1997

Compiled by
Paul T. Carlson

July 1997

Prepared for
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Office of Fossil Energy

by

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
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**PUBLICATIONS OF THE OAK RIDGE NATIONAL LABORATORY
FOSSIL ENERGY PROGRAM AND THE AR&TD MATERIALS PROGRAM***

April 1, 1995, through March 31, 1997

Compiled by
Paul T. Carlson

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 April 1, 1995, through March 31, 1997, and is a supplement to the earlier bibliographies in this series (see page iii). 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 activity of the Fossil Energy Program is the Advanced Research and Technology Development (AR&TD) Materials Program. 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. Program work is conducted at national and government laboratories, universities, and industrial research facilities. Beginning with this report, publications of the AR&TD Materials Program, previously compiled in separate reports¹⁻⁶, and publications from non-materials activities of the Fossil Energy Program will be combined in a single report.

The environmental analysis support 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 Federal Energy Technology Centers in Morgantown, West Virginia, and Pittsburgh, Pennsylvania.

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Introduction

Bioprocessing research at ORNL involves the conversion of coal to useful liquid and gaseous fuels as well as the removal of heteroatoms and hazardous materials from coal, coal liquids, combustion gases, and other gaseous and liquid effluents and products. Innovative microbial and biochemical pathways for bioprocessing concepts are being investigated for use in these areas, and advanced bioreactor systems that can efficiently and economically carry out such processes are being developed. Other biocatalytic systems are being investigated to remove organically bound sulfur that contaminates coal-derived liquids. Other research is focused on the production of molecular hydrogen via photosynthetic water splitting. Other cooperative research is involved with the removal of sulfur, nitrogen, and other contaminants from crude petroleum and other refinery streams.

Coal combustion research includes the analysis and control of deterministic chaos in fluidized-bed and pulverized coal combustion. Collaborations with university and industrial partners are aimed at the development of improved fossil energy process control through application of chaos theory.

ORNL provides assistance to the Strategic Petroleum Reserve Program in the development of models for planning the capacity and management of the Strategic Petroleum Reserve, and for analyzing the oil market.

REFERENCES

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 Natl. Lab., 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 Natl. Lab., 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 Natl. Lab., 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 Natl. Lab., June 1991.

5. Paul 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 Natl. Lab., June 1993.
6. Paul T. Carlson, *Publications of the Fossil Energy Advanced Research and Technology Development Materials Program, April 1, 1993, through March 31, 1995*, ORNL/FMP-95/2, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., April 1995.

2. MATERIALS RESEARCH AND DEVELOPMENT

2.1 PROGRAMMATIC REPORTS

Papers in Conference Proceedings

N. C. Cole and R. R. Judkins, comps., *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

N. C. Cole and R. R. Judkins, comps., *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

2.2 METALS—ALLOY DEVELOPMENT

Open Literature Publications

S. C. Deevi and V. K. Sikka, "Exo-Melt™ Process for Melting and Casting Intermetallics," *Intermetallics* 5(1), 17–27 (1997).

S. C. Deevi and V. K. Sikka, "Nickel and Iron Aluminides: An Overview on Properties, Processing, and Applications," *Intermetallics* 4(5), 357–75 (1996).

S. C. Deevi, C. J. Swindeman, V. K. Sikka, and R. D. Seals, "Application of Reaction Synthesis Principles to Thermal Spray Coatings of Intermetallics," *J. Mater. Sci.* (in press, 1997).

V. K. Sikka, S. C. Deevi, and J. D. Vought, "Exo-Melt™, A Commercially Viable Process for Melting Aluminides," *Adv. Mater. Processes* 147(6), 29–31 (June 1995).

Papers in Conference Proceedings

S. C. Deevi and V. K. Sikka, "Reaction Synthesis of Heat-Resistant Materials," pp. 275–86 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

S. C. Deevi and V. K. Sikka, "Reaction Synthesis of Intermetallics," pp. 917–22 in *Materials Research Society Proceedings Vol. 364, High Temperature Ordered Intermetallics VI*, Boston, MA, Nov. 28–Dec. 1, 1994, ed. J. A. Horton, L. Baker, S. Hanada, R. D. Noebe, and D. S. Schwartz, Materials Research Society, Pittsburgh, 1995.

S. C. Deevi, V. K. Sikka, and C. T. Liu, "Processing, Properties, and Applications of Nickel and Iron Aluminides," Proceedings of Conference on Perspectives in Materials Sciences, Bangalore, India, Dec. 19, 1995 (to be published in *Progress of Materials Science*, 1997).

C. G. McKamey, Y. Marrero-Santos, and P. J. Maziasz, "Effect of Heat Treatment at 1150°C on Creep-Rupture Properties of an Fe₃Al-Based Alloy," pp. 249–54 in *Materials Research Society Proceedings Vol. 364, High Temperature Ordered Intermetallics VI, Boston, MA, Nov. 28–Dec. 1, 1994*, ed. J. A. Horton, L. Baker, S. Hanada, R. D. Noebe, and D. S. Schwartz, Materials Research Society, Pittsburgh, 1995.

C. G. McKamey and P. J. Maziasz, "Effect of Heat Treatment at 1150°C on Creep-Rupture Properties of Alloy FA-180," pp. 215–23 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

C. G. McKamey, P. J. Maziasz, and Y. Marrero-Santos, "Effects of Composition and Heat Treatment at 1150°C on Creep-Rupture Properties of Fe₃Al-Based Alloys," pp. 369–76 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

V. K. Sikka, "Melting, Casting, and Processing of Nickel and Iron Aluminides," pp. 873–78, in *High-Temperature Ordered Intermetallic Alloys VI, Part 2, Vol. 346*, Mat. Res. Soc. Symp. Proc., Boston, Nov. 28–Dec. 1, 1994, Materials Research Society, Pittsburgh, 1995.

V. K. Sikka and S. C. Deevi, "Intermetallics for Structural Applications," pp. 567–78 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

S. Viswanathan, V. K. Andleigh, and C. G. McKamey, "The Effect of Grain Refinement on the Room-Temperature Ductility of As-Cast Fe₃Al-based Alloys," pp. 97–102 in *Materials Research Society Proceedings Vol. 364, High Temperature Ordered Intermetallics VI, Boston, MA, Nov. 28–Dec. 1, 1994*, ed. J. A. Horton, L. Baker, S. Hanada, R. D. Noebe, and D. S. Schwartz, Materials Research Society, Pittsburgh, 1995.

S. Viswanathan, C. G. McKamey, and P. J. Maziasz, "The Effect of Alloying and Grain Refinement on the Room-Temperature Ductility of As-Cast Fe₃Al-Based Alloys," pp. 387–96 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

I. G. Wright, C. G. McKamey, and B. A. Pint, "ODS Iron Aluminides," pp. 355–67 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

Books and Book Articles

C. G. McKamey, "Iron Aluminides," pp. 351–91 in *Physical Metallurgy and Processing of Intermetallic Compounds*, ed. N. S. Stoloff and V. K. Sikka, Chapman & Hall, New York, 1996.

V. K. Sikka, "Intermetallics for Structural Applications," pp. 1–118 in *Oxidation and Corrosion of Intermetallic Alloys*, ed. G. Welsch and P. D. Desai, CINDAS, Purdue University, West Lafayette, Ind., 1996.

V. K. Sikka, "Processing of Aluminides," pp. 561–604 in *Physical Metallurgy and Processing of Intermetallics Compounds*, ed. N. S. Stoloff and V. K. Sikka, Chapman and Hall, New York, 1996.

N. S. Stoloff and V. K. Sikka, eds. *Physical Metallurgy and Processing of Intermetallics Compounds*, Chapman and Hall, New York, 1996.

2.3 METALS—MECHANICAL PROPERTIES

Open Literature Publications

D. A. Alven, "Fatigue Crack Growth of Fe₃Al,Cr Alloys," *Scripta Metallurgica* **34**, 1937–42 (1996).

C. R. Clark, R. N. Wright, J. K. Wright, and B. H. Rabin, "Elevated Temperature Mechanical Properties of Reaction Synthesized Fe₃Al," *Script Metall. et Mater.* **32**, 1883–88 (1995).

J. H. Zhu, P. K. Liaw, and C. T. Liu, "Electron Concentration and Phase Stability in NbCr₂-Based Laves Phase Alloys," *Metall. Trans.* (in press).

Topical Reports

V. K. Sikka, G. M. Goodwin, D. J. Alexander, and C. R. Howell, *Welding and Mechanical Properties of Cast FAPY (Fe-16 at. % Al-Based) Alloy Slabs*, ORNL/TM-12944, Oak Ridge Natl. Lab., May 1995.

Papers in Conference Proceedings

D. A. Alven and N. S. Stoloff, "The Influence of Composition on Environmental Embrittlement of Iron Aluminides," pp. 225–35 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

J. A. Cook, P. K. Liaw, and C. T. Liu, "The Effects of Microstructural Control on the Mechanical Behavior of Cr₂Nb-Based Alloys," pp. 335–48, in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

J. A. Cook, P. K. Liaw, C. T. Liu, and S. B. Bhaduri, "The Effects of Microstructural Control on the Mechanical Behavior of Cr₂Nb-Based Intermetallic Alloys," pp. 47–60 in *The Johannes Weertman Symposium*, ed. R. J. Arsenault, D. Cole, T. Gross, G. Kostorz, P. Liaw, S. Parameswaran and H. Sizek, TMS, Warrendale, Pa., 1996.

B. S. Kang, Q. Yao, and B. R. Cooper, "Evaluation of the Intrinsic and Extrinsic Fracture Behavior of Iron Aluminides," pp. 405–17 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

T. M. Lillo, R. N. Wright, J. K. Wright, and B. H. Rabin, "Processing Influences on Elevated Temperature Properties of Reaction Synthesized Fe₃Al," pp. 579–84 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

V. K. Sikka, C. R. Howell, F. Hall, and J. Vallykeo, "Processing and Properties of Low-Aluminum Alloy FAPY," pp. 261–71 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

R. N. Wright, J. K. Wright, C. H. Sellers, T. A. Hyde, and T. K. O'Brien, "Phase Transformations in Fe₃Al Alloyed with Ti and Cr," pp. 49–56 in *Mechanical Properties and Phase Transformations in Multi-Component Intermetallics*, proceedings of the Symposium on Mechanical Properties and Phase Transformations in Multi-Component Intermetallics at the TMS Fall Meeting, Rosemont, Ill, Oct. 3–6, 1994, ed. A. F. Giamei et al., TMS, Warrendale, Pa, 1995.

J. H. Zhu, P. K. Liaw, and C. T. Liu, "Study of Fatigue and Fracture Behavior of NbCr₂-Based Alloys and Intermetallic Materials: Phase Stability in Cr₂Nb-Based Laves Phase Alloys," pp. 491–500 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

Books and Book Articles

R. J. Arsenault, D. Cole, T. Gross, G. Kostorz, P. K. Liaw, S. Parameswaran, and H. Sizek, eds., *The Johannes Weertman Symposium*, TMS, Warrendale, Pa., 1996.

A. Castagna and N. S. Stoloff, "Effects of Hydrogen on Fatigue Crack Growth of Iron Aluminides," pp. 1171–76 in *High Temperature Ordered Intermetallic Alloys VI*, Materials Research Society Symposium Proc. 364(2) (1995).

S. N. G. Chu, P. K. Liaw, R. J. Arsenault, K. Sadananda, K. S. Chan, W. W. Gerberich, C. C. Chau, and T. M. Kung, eds., *Micromechanics of Advanced Materials: A Symposium Dedicated to Prof. James C. M. Li's Seventieth Birthday*, TMS, Warrendale, Pa., 1995.

N. S. Stoloff, "Fatigue," pp. 126–55 in *Physical Metallurgy and Processing of Intermetallic Compounds*, ed. N. S. Stoloff and V. K. Sikka, Chapman and Hall, 1996.

N. S. Stoloff and V. K. Sikka, *Physical Metallurgy and Processing of Intermetallic Compounds*, Chapman and Hall, New York, 1996.

2.4 METALS—JOINING

Open Literature Publications

S. W. Banovic, J. N. DuPont, and A.R. Marder, "Processing-Composition-Microstructure Relationships of Iron Rich Fe-Al Weld Overlay Coatings" (for submission to *J. Mat. Sci.*).

A. A. Fasching, G. R. Edwards, and S.A. David, "Grain Refinements and Hydrogen Embrittlement in Iron-Aluminide Alloy FA-129," *Sci. and Tech. of Weld. and Join.* (in press).

Topical Reports

S. W. Banovic, J. N. DuPont, and A.R. Marder, *Processing and Structure of In Situ Fe-Al Alloys Produced by Gas Tungsten Arc Welding*, ORNL/Sub/95-SU604/01, Oak Ridge Natl. Lab., Feb. 1997.

V. K. Sikka, G. M. Goodwin, D. J. Alexander, and C. R. Howell, *Welding and Mechanical Properties of Cast FAPY (Fe-16 at. % Al-Based) Alloy Slabs*, ORNL/TM-12944, Oak Ridge Natl. Lab., May 1995.

Papers in Conference Proceedings

R. P. Burt, G. R. Edwards, and S. A. David, "Effects of Titanium and Zirconium on Iron Aluminide Weldments," pp. 237-46 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

J. N. DuPont, S. W. Banovic, and A.R. Marder, "Evaluation of Iron Aluminide Weld Overlays for Erosion-Corrosion Resistant Boiler Tube Coatings in Low NO_x Boilers," pp. 247-50 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

A. A. Fasching, G. R. Edwards, R. P. Burt, and S. A. David, "Weldability of Polycrystalline Aluminides," pp. 397-406 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

A. A. Fasching, G. R. Edwards, and S. A. David, "Use of Magnetic Arc Oscillation to Refine Fusion Zone Grain Size in an Iron Aluminide Alloy Weldment," pp. 147-52 in *Proceedings of 4th Int. Conf. on Trends in Welding Research, Gatlinburg, TN, June 5-8, 1995*.

Z. Feng, X.-L. Wang, S. Spooner, G. M. Goodwin, P. J. Maziasz, C. R. Hubbard, and T. Zacharia, "A Finite Element Model for Residual Stress in Repair Welds," proceedings of the Am. Soc. Mech. Engr. Pressure Vessel and Piping Conference on Welding-Induced Residual Stress in Pressure Vessels and Piping, Montreal, July 21-26, 1996.

G. M. Goodwin, "Weld Overlay Cladding with Iron Aluminides," pp. 281-87 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

G. M. Goodwin, "Weld Overlay Cladding with Iron Aluminides," pp. 381-92 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

C. D. Lundin and C. Y. P. Qiao, "Microstructure Characterization of and Weldability Evaluation of the Weld Heat Affected Zone (HAZ) in 310HCbN Tubing," pp. 325-34 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

C. D. Lundin and C. Y. P. Qiao, "Tube Weld Cracking Test," *Proceedings of the Heat Resistant Materials Conference II*, ASM Sept. 1995.

C. D. Lundin, C. Y. P. Qiao, and R. W. Swindeman, "Microstructural and Weldability Evaluation of 310TaN," pp. 445-54 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

P. J. Maziasz et al., "Alloy Development and Processing of FeAl: An Overview," *Proceedings of the Intl. Conf. on Nickel and Iron Aluminides: Processing, Properties, and Applications*, Cincinnati, Oct. 7-9, 1996, to be published by ASM Intl., Materials Park, Ohio, 1997.

M. L. Santella and G. M. Goodwin, "Recent Developments in Welding of Ni₃Al and Fe₃Al Alloys," *Proceedings of the Am. Soc. Met./Min. Met. Mater. Soc. Materials Week*, Cincinnati, October 6-10, 1996.

P. F. Tortorelli, I. G. Wright, G. M. Goodwin, and M. Howell, "High-Temperature Oxidation/Sulfidation Resistance of Iron-Aluminide Coatings," *Proceedings of the Annual Meeting Metall. Soc., High-Temperature Coatings II Symposium*, Anaheim, Calif., Feb. 8-11, 1996.

X.-L. Wang, S. Spooner, Z. Feng, C. R. Hubbard, P. J. Maziasz, and G. M. Goodwin, "Residual Stress in a Single-Pass FeAl Weld Overlay on Steel," *Proceedings of the Fall Meet. Mater. Res. Soc.*, Boston, Nov. 18-21, 1996.

Books and Book Articles

R. P. Burt, G. R. Edwards, and S. A. David, "Fusion Zone Refinements of Iron Aluminide Weldments by Titanium Inoculation," in *Processing and Fabrication of Advanced Materials V*, TMS, Cincinnati, 1997.

2.5 METALS—COATINGS DEVELOPMENT

Open Literature Publications

D. Doppalapudi et al., "Structure of Mullite Coatings Grown by Chemical Vapor Deposition," *Mat. Sci. and Eng. A* (submitted Aug. 1996).

N. He, G. Wang, and R. A. Rapp, "The Common Component Effect in Multiphase, Multicomponent Equilibria," *Materials Sci. & Eng. A* **192/193**, 980-87 (1995).

Y-R He, R. A. Rapp and P. F. Tortorelli, "Oxidation-Resistant Coating on Cr-Cr₂Nb Alloys by Pack Cementation," accepted for publication in *Materials Sci. and Eng.*, Aug. 1996.

C. McVay and R. A. Rapp, "Diffusion Aluminizing Coatings to Produce Ni₃Al Alloy Welding Rods," *Script. Met. & Mater.* **33j**, 201-4 (1995).

O. R. Monteiro, Z. Wang, and I. G. Brown, "Deposition of Mullite and Mullite-Like Coatings on Silicon Carbide by Dual-Source Metal Plasma Immersion," *J. Mat. Res.* (to be published).

R. P. Mulpuri, "Synthesis of Mullite Coatings by Chemical Vapor Deposition," *J. Mater. Res.* **11**(6), 1315-24 (June 1996).

V. K. Sarin, "Systematic Development of CVD Coatings," *Surface and Coatings Technology* **73**, 23-33 (1995).

V. K. Sarin et al., "Corrosion Protection of SiC-Based Ceramics with CVD Mullite Coatings," *Ceramic Technology Newsletter* **51**, 6-8 (December 1996).

M. Zheng and R. A. Rapp, "Simultaneous Aluminizing and Chromizing of Steels To Form (Fe,Al)₃Al Coatings," accepted for publication in *Oxid. Metals*, May 1996.

Topical Reports

Ian Brown, *Deposition of Mullite and Mullite-like Coatings on Silicon Carbide by Dual-Source Metal Plasma Immersion*, Topical Report of Work on Subcontract 10X-SS109V, Lawrence Berkeley National Laboratory, Oct. 1995-Sept. 1996.

V.K. Sarin, R. Mulpuri, and M. Auger, *Corrosion Protection of SiC-Based Ceramics with CVD Mullite Coatings*, ORNL/Sub/94-SS110/01, Oak Ridge Natl. Lab., April 1996.

Papers in Conference Proceedings

Ian Brown and Zhi Wang, "Plasma Synthesis of Alumina Films on Metal and Ceramic Substrates," p. 239 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

D. Doppalapudi et al., "Structural Evolution of Mullite Coatings on Silicon-Based Ceramics," pp. 664-70 in the *Proceedings of the XIII Annual CVD Conference*, as part of the Electrochemical Society Meeting held in Los Angeles, May 5-10, 1996, ed. T. M. Besmann, The Electrochemical Society, Inc., Pennington, N.J., 1996.

P. Y. Hou, K. B. Alexander, Z. Wang, and I.G. Brown, "The Effect of Plasma Synthesized Alumina Coatings on the Oxidation Behavior of Iron Aluminides," p. 187 in *Elevated Temperature Coatings: Science and Technology II*, Proc. TMS Annual Meeting, Symposium on High Temperature Coatings, Anaheim, Calif., Feb 4-8, 1996, ed. N.B. Dahotre and J. M. Hampikian, the Minerals, Metals, and Materials Society, 1996.

P. Y. Hou, Z. Wang, K. Prussner, K. B. Alexander and I. G. Brown, "Sulfur Segregation to Oxide/Metal Interfaces: a Comparison of Thermally Grown and Plasma Deposited Al_2O_3 ," in *Proc. 3rd Int. Conf. on Microscopy of Oxidation*, Cambridge, United Kingdom, Sept. 16–18, 1996.

R. N. Johnson, "Electrospark Deposition: Robust Coatings for Severe Service Applications," pp. 481–508 in *Proceedings of the 3rd Annual Advanced Techniques for Replacing Chromium*, Champion, Pa., Nov. 4–6, 1996, Concurrent Technologies Corp., Pa., 1997.

O. R. Monteiro and I. G. Brown, "Plasma Synthesis of High Temperature Hard Ceramic Coatings," in *Proceedings of ARO-UM Workshop on Hot Gas Erosion and Wear of Materials*, Ann Arbor, Mich., Sept. 25–27, 1996.

O. R. Monteiro, Z. Wang, and I. G. Brown, "Synthesis of Multi-Element Thin-Films using Mixed Metal Plasma Streams," in *Proc 10th Int. Conf. on Ion Beam Modification of Materials (IBMM'96)*, Albuquerque, N.M., Sept. 1–6, 1996.

O. R. Monteiro, Z. Wang, K.-M. Yu, P. Y. Hou, I.G. Brown, B. H. Rabin, and G. F. Kessinger, "Plasma Deposition of High Temperature Protective Coatings," p. 97 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

K. Natesan and R. N. Johnson, "Corrosion Performance of Fe-Cr-Al and Fe Aluminide Alloys in Complex Gas Environments," pp. 591–600 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

R. N. Wright, J. R. Fincke, W. D. Swank, D. C. Haggard, and C. R. Clark, "The Influence of Processing Parameters on Microstructure and Properties of Fe_3Al Based Coatings," pp. 157–162 in *Elevated Temperature Coatings: Science and Technology, Proceedings of the Symposium on Elevated Temperature Coatings: Science and Technology at the TMS Fall Meeting*, Rosemont, IL Oct. 3–6, 1994, ed. N.B. Dahotre et al., TMS, Warrendale, Pa., 1995.

Books and Book Articles

R. N. Johnson, "Electrospark Deposited Coatings for High Temperature Wear and Corrosion Applications," pp. 265–77 in *Elevated Temperature Coatings, Science and Technology I*, ed. N. B. Dahotre, J. M. Hampikian, and J. J. Stiglich, The Minerals, Metals, and Materials Society, Warrendale, Pa., 1995.

2.6 METALS—CORROSION AND ENVIRONMENTAL EFFECTS

Open Literature Publications

M. L. Johnson, D. E. Mikkola, and R. N. Wright, "Cavitation Erosion and Abrasive Wear of Ni_3Al Alloys," *Intermetallics* 3 389–95 (1995).

D. Renusch, B. Veal, K. Natesan, and M. Grimsditch, "Transient Oxidation in Fe-Cr-Ni Alloys: A Raman-Scattering Study," *Oxidation of Metals* 46(5/6), 365-81, 1996.

Topical Reports

J. L. Blough, *Fireside Corrosion Testing of Candidate Superheater Tube Alloys, Coatings, and Claddings—Phase II Testing*, ORNL/Sub/93-SM401/01, Oak Ridge Natl. Lab., August 1996.

K. Natesan, K. Klug, D. Renusch, B. W. Veal, and M. Grimsditch, *Microstructural and Mechanical Characterization of Alumina Scales Thermally Developed on Iron Aluminide Alloys*, ORNL/Sub/94-SS108V/02, Oak Ridge Natl. Lab., November 1995.

A. R. Olsen, R. R. Judkins, and J. R. Keiser, *Assessment of Materials Selection and Performance for Direct-Coal-Liquefaction Plants in the United States*, ORNL-6382, Oak Ridge Natl. Lab., Sept. 1996.

P. F. Tortorelli, J. H. DeVan, R. R. Judkins, and I. G. Wright, *Carbon Formation and Metal Dusting in Hot-Gas Cleanup Systems of Coal Gasifiers*, ORNL/TM-13014, Oak Ridge Natl. Lab., February 1997.

Papers in Conference Proceedings

K. B. Alexander, K. Prübner, and P. F. Tortorelli, "The Mechanical Reliability of Alumina Scales and Coatings," pp. 419-27 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

J. L. Blough and G. J. Stanko, "Coal Ash Corrosion Testing of Advanced Alloys," *Corrosion/97*, New Orleans, Mar. 9-14, 1997, Paper 97140, NACE International, Houston, 1997.

J. L. Blough and G. J. Stanko, "Fireside Corrosion Testing of Candidate Superheater Tube Alloys, Coatings, and Claddings—Phase II Field Testing," pp. 435-45 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

J. L. Blough and G. J. Stanko, "Fireside Corrosion Testing of Candidate Superheater Tube Alloys, Coatings, and Claddings—Phase II Field Testing," pp. 455-64 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

R. R. Judkins, P. F. Tortorelli, and I. G. Wright, "Metal Filter Materials in Combustion Environments," in *Proceedings of the Advanced Coal-Fired Power Systems '96 Review Meeting*, Morgantown, W. Va., July 16-18, 1996, DOE/METC-96/1037, U. S. Department of Energy Office of Fossil Energy, Morgantown Energy Technology Center, 1996.

K. Natesan, "Effect of Oxidation/Sulfidation on Creep Behavior of Alloy 800," pp. 353–60 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

K. Natesan and R. N. Johnson, "Corrosion Performance of Fe-Cr-Al and Fe Aluminide Alloys in Complex Gas Environments," pp. 591–600 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

K. Natesan, M. Freeman, and M. Mathur, "Corrosion and its Effect on Mechanical Properties of Materials for Advanced Combustion Systems," pp. 63–73 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials*, May 14–16, 1996, Knoxville, Tennessee, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

K. Natesan, M. Freeman, and M. Mathur, "Corrosion Performance of Materials for Advanced Combustion Systems," pp. 71–84 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials*, May 16–18, 1995, Oak Ridge, Tenn., comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

B. A. Pint, "The Morphology of Al_2O_3 Scales: Indicators of Phase, Growth Mechanisms and Grain Boundary Segregation," pp. 74–85 in *Fundamental Aspects of High Temperature Corrosion VI*, Symp. Proc. Vol. 96-26, ed. D. A. Shores, R. A. Rapp, and P. Y. Hou, The Electrochemical Society, 1997.

P. F. Tortorelli and K. B. Alexander, "Mechanically Reliable Scales and Coatings," pp. 247–56 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials*, May 16–18, 1995, Oak Ridge, Tenn., comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

P. F. Tortorelli and B. A. Pint, "Oxidation Behavior of Cr-Cr₂Nb Alloys," pp. 174–85 in *Fundamental Aspects of High Temperature Corrosion VI*, Symp. Proc. Vol. 96-26, ed. D. A. Shores, R. A. Rapp, and P. Y. Hou, The Electrochemical Society, 1997.

P. F. Tortorelli, J. H. DeVan, G. M. Goodwin, and M. Howell, "High-Temperature Corrosion Resistance of Weld Overlay Coatings of Iron Aluminide," pp. 203–312 in *Elevated Temperature Coatings: Science and Technology I*, ed. N. B. Dahotre, J. M. Hampikian, and J. J. Stiglich, The Minerals, Metals, and Materials Society, 1995.

P. F. Tortorelli, J. H. DeVan, B. A. Pint, and I. G. Wright, "High-Temperature Corrosion Behavior of Iron-Aluminide Alloys and Coatings," pp. 289–300 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials*, May 16–18, 1995, Oak Ridge, Tennessee, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

P. F. Tortorelli, G. M. Goodwin, M. Howell, and J. H. DeVan, "Weld-Overlay Iron-Aluminide Coatings For Use in High-Temperature Oxidizing/Sulfidizing Environments," pp. 585–90 in *Heat-Resistant Materials II: Proceedings of Second International Conference on Heat-Resistant Materials*, Gatlinburg, Tenn., Sept. 11–14, 1995, ed. K. Natesan, P. Ganesan, and G. Lai, ASM International, Materials Park, Ohio, 1995.

P. F. Tortorelli, R. R. Judkins, J. H. DeVan, and I. G. Wright, "Carbon Formation and Metal Dusting in Hot-Gas Cleanup Systems of Coal Gasifiers," pp. 292-301 in *Proceedings of the Advanced Coal-Fired Power Systems '95 Review Mtg.*, ed. H. M. McDaniel, D. J. Mollet, and V. K. Venkataraman, Vol. 1, DOE/METC-95/1018, U. S. Department of Energy Office of Fossil Energy, Morgantown Energy Technology Center, Morgantown, W. Va., 1995.

P. F. Tortorelli, B. A. Pint, and I. G. Wright, "High-Temperature Corrosion Behavior of Coatings and ODS Alloys Based on Fe₃Al," pp. 393-403 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

P. F. Tortorelli, I. G. Wright, G. M. Goodwin, and M. Howell, "High-Temperature Oxidation/Sulfidation Resistance of Iron Aluminide Coatings," pp. 175-85 in *Elevated-Temperature Coatings: Science and Technology II*, ed. N. B. Dahotre and J. M. Hampikian, The Minerals, Metals, and Materials Society, 1996.

I. G. Wright, B. A. Pint, E. K. Ohriner, and P. F. Tortorelli, "ODS Iron Aluminides," pp. 359-71 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

Books and Book Articles

P. F. Tortorelli, and J. H. DeVan, "Oxidation and Other Corrosion Phenomena at Intermediate Temperatures (300-800°C)," Chapter 3 in *Oxidation and Corrosion of Intermetallic Alloys*, ed. G. Welsh and P. D. Desai, Metals Information Analysis Center, Purdue University, West Lafayette, Ind., 1996.

2.7 CERAMICS—FIBER-REINFORCED COMPOSITES

Open Literature Publications

T. M. Besmann, J. C. McLaughlin, and H.-T. Lin, "Fabrication of Ceramic Composites: Forced CVI," *Journal of Nuclear Materials* **219**, 31 (1995).

K. K. Chawla, P. K. Liaw, and S. G. Fishman, "Conference Review on High Performance Composites: Commonality of Phenomena," *J. of Metals* **48**(2), 43-44 (1996).

W. Y. Lee, K. M. Cooley, C. C. Berndt, D. L. Joslin, and D. P. Stinton, "High Temperature Chemical Stability of Plasma Sprayed Ca_{0.5}Sr_{0.5}Zr₄P₆O₂₄ Coatings on Nicalon/SiC Ceramic Matrix Composite and Ni-Based Superalloy Substrates," *J. Am. Ceram. Soc.* **79**(10), 2759-62 (October 1996).

W. Y. Lee, K. L. More, D. P. Stinton, and Y. W. Bae, "Characterization of Si₃N₄ Coated with Chemically Vapor Deposited Mullite after Na₂SO₄ Induced Corrosion," *J. Am. Ceram. Soc.* **79**(9) 2489-92 (1996).

W. Y. Lee, D. P. Stinton, and D. L. Joslin, "Interaction of Low-Expansion NZP Ceramics with Na_2SO_4 at 1000°C ," *J. Am. Ceram. Soc.* **79**(2), 484–86 (February 1996).

P. K. Liaw, "Commentary: Expanding the Application of Ceramic-Matrix Composites," *J. of Metals* **47**(10), 29 (1995).

P. K. Liaw, "Fiber-Reinforced CMCs: Processing, Mechanical Behavior and Modeling," *J. of Metals* **47**(10), 38–44 (1995).

P. K. Liaw, D. K. Hsu, N. Yu, N. Miriyala, V. Saini, and H. Jeong, "Investigation of Metal and Ceramic-Matrix Composites Moduli: Experiment and Theory," *Acta Metallurgica et Materialia* **44** (5), 2101–13 (1996).

P. K. Liaw and N. Yu, "Commentary: Modeling the Micromechanical Aspects of Composites," *J. of Metals* **48**(9), 43 (1996).

P. K. Liaw, N. Yu, D. K. Hsu, N. Miriyala, V. Saini, L. L. Snead, C. J. McHargue, and R. A. Lowden, "Moduli Determination of Continuous Fiber Ceramic Composites (CFCCs)," *J. of Nuclear Materials* **219**, 93–100 (1995).

N. Miriyala and P. K. Liaw, "The Monotonic and Fatigue Behavior of CFCCs," *J. of Metals* **48**(9), 44–52 (1996).

R. Pitchumani, P. K. Liaw, S. C. Yao, H. Jeong, and D. K. Hsu, "Theoretical Models for the Anisotropic Conductivities of Two and Three-phase Metal-Matrix Composites," *Acta Metallurgica et Materialia* **43**(8), 3045–59 (1995).

S. Shanmugham, D. P. Stinton, F. Rebillat, A. Bleier, T. M. Besmann, E. Lara-Curzio, and P. K. Liaw, "Oxidation-Resistant Interfacial Coatings for Continuous Fiber Ceramic Composites," *Ceram. Eng. & Sci. Proc.* **16**(4), 389–99 (1995).

T. L. Starr, "Gas Transport Model for Chemical Vapor Infiltration," *J. Mat. Res.* **10**(9), 1–7 (1995).

T. L. Starr, D. Y. Chiang, T.M. Besmann, D.P. Stinton, J. C. McLaughlin, and W. M. Matlin, "Rapid Fabrication of Ceramic Composite Tubes Using Chemical Vapor Infiltration," *Ceram. Trans.* **79**, 127–34 (1996).

D. P. Stinton, D. M. Hembree, Jr., K. L. More, B. W. Sheldon, T. M. Besmann, M. H. Headinger, and R. F. Davis, "Matrix Characterization of Fiber-Reinforced SiC Matrix Composites Fabricated by Chemical Vapor Infiltration," *J. Mater. Sci.* **30**, 4279–85 (1995).

S. Vaidyaraman, W. J. Lackey, P. K. Agrawal, and T.L. Starr, "1-D Model for Forced Flow-Thermal Gradient Chemical Vapor Infiltration Process for Carbon," *Carbon* **34**(9) 1123–33 (1996).

Topical Reports

S. Shanmugham and P. K. Liaw, *Processing and Mechanical Behavior of Nicalon/SiC Composites with Sol-Gel Derived Oxide Interfacial Coatings*, ORNL/Sub/95-99732S64/01, NTIS, U.S. Department of Commerce, Springfield, Va., Oct. 1996.

A.W. Smith and T.L. Starr, *Finite-Volume Model for Chemical Vapor Infiltration Incorporating Radiant Heat Transfer*, ORNL/Sub/85-55901/05, Georgia Institute of Technology, Atlanta, May 1995.

T.L. Starr and N. Hablutzel, *Measurement of Gas Transport Properties for Chemical Vapor Infiltration*, ORNL/Sub/87-00184/06, Georgia Institute of Technology, Atlanta, December 1996.

Papers in Conference Proceedings

T. M. Besmann, W. M. Matlin, D. P. Stinton, and P. K. Liaw, "Fabrication of Fiber-Reinforced Composites by Chemical Vapor Infiltration," pp. 1-9 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

T. M. Besmann, S. Shanmugham, E. R. Kupp, and D. P. Stinton, "Approach to Inherently Stable Interfaces for Ceramic Matrix Composites," pp. 371-80 in *Proceedings of the American Society for Composites: Eleventh Technical Conference, Atlanta, GA, October 7-9, 1996*, ed. W. S. Johnson, Technomic Publishing, Lancaster, Pa., 1996.

T. M. Besmann, D. P. Stinton, E. R. Kupp, S. Shanmugham, and P. K. Liaw, "Fiber-Matrix Interfaces in Ceramic Matrix Composites," *Interfacial Engineering*, Materials Research Society Proceedings, Dec. 1996.

D. Y. Chiang and T.L. Starr, "Modeling of Fibrous Preforms for CVI Fabrication," pp. 161-70 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

D. Y. Chiang and T.L. Starr, "Optimization of Composite Processing Using CVI," pp. 381-89 in *Proceedings of the American Society for Composites: Eleventh Technical Conference, Atlanta, GA, October 7-9, 1996*, ed. W. S. Johnson, Technomic Publishing, Lancaster, Pa., 1996.

W. A. Curtin, L. L. Oleksuk, K. L. Reifsnider, and D. P. Stinton, "Mechanical Properties of Ceramic Composite Tubes," pp. 31-39 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, Oak Ridge, Tennessee, May 16-18, 1995*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

M. A. Janney and D. P. Stinton, "Development of Materials for Microwave-Heated Diesel Particulate Filters," pp. 175-83 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

E. R. Kupp, E. Lara-Curzio, D. P. Stinton, R. A. Lowden, and T. M. Besmann, "CVI Processing of Minicomposites for Evaluation of Interface Coating Material in Composites," pp. 600–606 in *CVD XIII. Proceedings of the Thirteenth International Conference on Chemical Vapor Deposition*, Vol. 96-5, ed. T. M. Besmann, M. D. Allendorf, McD. Robinson, and R. K. Ulrich, The Electrochemical Society, Pennington, N.J., 1996.

W. M. Matlin, D. P. Stinton, and T. M. Besmann, "Fabrication of Fiber-Reinforced Composites by Chemical Vapor Infiltration," pp. 157–65 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

W. M. Matlin, D. P. Stinton, T. M. Besmann, and P. K. Liaw, "Optimization of Bundle Infiltration in the Forced Chemical Vapor Infiltration (FCVI) Process," p. 309 in *Ceramic Matrix Composites—Advanced High-Temperature Structural Materials*, Materials Research Society Symposium Proceedings, Vol. 365, ed. R. A. Lowden, M. K. Ferber, J. R. Hellman, K. K. Chawla, and S. G. DiPietro, Materials Research Society, Pittsburgh, 1995.

Y. G. Roman and D. P. Stinton, "The Preparation and Economics of Silicon Carbide Matrix Composites by Chemical Vapor Infiltration," p. 343 in *Ceramic Matrix Composites—Advanced High-Temperature Structural Materials*, Materials Research Society Symposium Proceedings, Vol. 365, ed. R. A. Lowden, M. K. Ferber, J. R. Hellman, K. K. Chawla, and S. G. DiPietro, Materials Research Society, Pittsburgh, 1995.

S. Shanmugham, P. K. Liaw, D. P. Stinton, T. M. Besmann, K. L. More, W. D. Porter, A. Bleier, and S. T. Misture, "Development of Sol-Gel Derived Coatings for Nicalon/SiC Composites," pp. 71–78 in *Advanced Synthesis and Processing of Composites and Advanced Ceramics II, Ceramic Transactions*, Vol. 79, the American Ceramic Society, 1996.

T. L. Starr, "Recent Advances in Modeling of Chemical Vapor Infiltration," in *Proceedings of the Thirteenth Conference on CVD, Los Angeles, CA, May 5–10, 1996*, ed. T. M. Besmann, M. D. Allendorf, McD. Robinson, and R. K. Ulrich, the Electrochemical Society, Pennington, N.J., 1996.

T. L. Starr, "Transport Properties of Ceramic Composites," pp. 167–73 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

T. L. Starr and D.Y. Chiang, "Modeling of Fibrous Preforms for CVI Fabrication," pp. 13–18 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

T. L. Starr and N. Hablutzl, "Transport Properties of Ceramic Composites," pp. 11–19 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

T. L. Starr, W. J. Lackey and S. Vaidyaraman, "Forced Flow-Thermal Gradient Chemical Vapor Infiltration For Carbon-Carbon Composites: Modeling and Experiment," pp. 88–89 in *Proceedings of the 22nd Biennial Conference on Carbon*, San Diego, Calif., July 16–21, 1995, ed. Glen B. Engle, American Carbon Society, St. Mary's, Pa., July 1995.

D. P. Stinton, T. M. Besmann, A. Bleier, S. Shanmugham, and P. K. Liaw, "Oxidation-Resistant Interfacial Coatings for Continuous Fiber Ceramic Composites," pp. 1–12 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials*, May 16–18, 1995, Oak Ridge, Tennessee, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

D. P. Stinton, T. M. Besmann, W. M. Matlin, T. L. Starr, and W. A. Curtin, "Forced Chemical Vapor Infiltration of Tubular Geometries: Modeling, Design, and Scale-Up, p. 317 in *Ceramic Matrix Composites—Advanced High-Temperature Structural Materials*, Materials Research Society Symposium Proceedings, Vol. 365, ed. R. A. Lowden, M. K. Ferber, J. R. Hellman, K. K. Chawla, and S. G. DiPietro, Materials Research Society, Pittsburgh, 1995.

D. P. Stinton, E. R. Kupp, J. Hurley, R. A. Lowden, S. Shanmugham and P. K. Liaw, "Oxidation-Resistant Interface Coatings for SiC/SiC Composites," pp. 151–59 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials*, May 14–16, 1996, Knoxville, Tennessee, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

Books and Book Articles

T. M. Besmann, "CVI Processing of Ceramic Matrix Composites," *Proc. High Temperature Matrix Composites II*, *Ceramic Transactions* 58, 1 (1995).

T. M. Besmann, W. M. Matlin, and D. P. Stinton, "Chemical Vapor Infiltration Process Modeling and Optimization," pp. 441–51 in *Covalent Ceramics II: Non-Oxides*, Vol. 410, ed. A. R. Barron, G. S. Fischman, M. A. Fury, and A. F. Hepp, Materials Research Soc., Pittsburgh, 1996.

S. Shanmugham, P. K. Liaw, D. P. Stinton, T. M. Besmann, K. L. More, A. Bleier, W. D. Porter, and S. T. Mixture, "Development of Sol-Gel Derived Coatings for Nicalon/SiC Composites," pp. 71–78 in *Advanced Synthesis and Processing of Composites and Advanced Ceramics II*, *Ceramic Trans.* Vol. 79, American Ceramic Society, Westerville, Ohio, 1996.

2.8 CERAMICS—MECHANICAL BEHAVIOR

Open Literature Publications

K. Breder and V. J. Tennery, "Dynamic Fatigue Behavior of Two-Phase SiC and SiC-Particulate Reinforced Al₂O₃ at Elevated Temperatures," *Journal of the European Ceramic Society* (1997) (in press).

K. Breder, J. M. Canon, and R. J. Parten, "Strength and Corrosion Behavior of a SiC-Particulate Reinforced Al_2O_3 Composite in Hot Coal Combustion Environments," pp. 479-87 in *Ceramic Engineering Science Proceedings* 17(3) (1996).

B. Fabeny and W. A. Curtin, "Damage-Enhanced Creep and Rupture in Fiber-Reinforced Composites," *Acta Mater.* 44, 3439-2451 (1996).

N. Iyengar and W. A. Curtin, "Time-Dependent Failure in Fiber-Reinforced Composites by Fiber Degradation," *Acta Mater.* (1997) (to appear).

H. T. Lin and K. Breder, "Creep Deformation in Alumina-SiC Composite Produced Via a Directed Metal Oxidation Process," *J. Am. Cer. Soc.* 79(8), 2218-20 (1996).

N. Miraj, "Low Modulus, Oxidation Resistant Interface Coatings for SiC/SiC Composites," Master's Thesis, Department of Materials Science and Engineering, Virginia Polytechnic Institute and State University, December 1996.

Topical Reports

W. A. Curtin et al., *Long-Term Performance of Ceramic Matrix Composites at Elevated Temperatures: Modeling of Creep and Creep Rupture*, ORNL/Sub/87-SA946/05, Oak Ridge Natl. Lab., July 1996.

H. Halverson, "Improving Life Predictions: Theory and Experiment on Unidirectional and Crossply Polymer Matrix Composites," Master's Thesis, Department of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University, May 1996.

R. H. Mallett, *Specifications for Design Analysis of a Ceramic Hot Flue Gas Tubesheet*, MTI-TR-825, Mallett Technology, Inc., Research Triangle Park, N.C., Nov. 1996.

R. H. Mallett, *Thermal and Structural Design Analysis of a Ceramic Tubesheet*, MTI-TR- 911 Revision 1, ORNL/Sub/94-SR776V/01, Mallett Technology, Inc., Research Triangle Park, N.C., Nov. 1996.

Papers in Conference Proceedings

W. A. Curtin L. L. Olesuk, K. L. Reifsnider, and D. P. Stinton, "Mechanical Properties of Ceramic Composite Tubes," pp. 31-39 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

W. A. Ellingson, R. D. Koehl, H. P. Engel, J. A. Wilson, and J. B. Stuckey, "Development of Nondestructive Evaluation Methods for Structural Ceramics," pp. 145-55 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

W. A. Ellingson, J. P. Singh, E. A. Sivers, J. B. Stuckey, D. Christopher, S. L. Dieckman, S. Ahuja, and D. Singh, "Development of Nondestructive Evaluation Methods and Prediction of Effects of Flaws on the Fracture Behavior of Structural Ceramics," pp. 145-55 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

H. Halverson and W. A. Curtin, "Fiber/Matrix Interfaces for SiC/SiC Composites: Multilayer SiC Coatings," pp. 171-80 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

R. H. Mallett, "Thermal and Mechanical Analysis of a Ceramic Tubesheet," ASME Turbo Expo '95, Houston, June 5-8, 1995.

R. H. Mallett, R. W. Swindeman, and J. F. Zievers, "Thermal and Structural Analyses of a Filter Vessel Ceramic Tubesheet," pp. 127-32 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

D. Singh, J. P. Singh, and M. Sutaria, "Influence of Fiber Lay-Up Sequence on Mechanical Properties of SiC(f)/SiC Composites," Proc. 20th Ann. Conf. on Composites and Advanced Ceramics, American Ceramic Society, Cocoa Beach, Fla, Jan. 7-11, 1996, *Ceram. Eng. & Sci. Proc.* 17(4), 98-109 (1996).

J. P. Singh, D. Singh, and M. Sutaria, "Effects of Flaws on Fracture Behavior of Structural Ceramics," pp. 39-51 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

E. A. Sivers, W. A. Ellingson, S. A. Snyder, and D. A. Holloway, "CT Multiscan: Using Small Area Detectors to Image Large Dense Components," Proc. 40th Gas Turbine and Aeroengine Congress/Users Symp. and Expo., Houston, June 5-8, 1995, *Trans. of ASME, J. of Engr. for Gas Turbines and Power* 118, 1-6 (1996).

2.9 CERAMICS—SOLID STATE ELECTROLYTE SYSTEMS

Open Literature Publications

T. R. Armstrong, J. W. Stevenson, L. R. Pederson, and P. E. Raney, "Dimensional Instability of Doped Lanthanum Chromite." *J. Electrochem. Soc.* 143, 2919-25 (1996).

G. Hsieh, S. J. Ford, T. O. Mason, and L. R. Pederson, "Experimental Limitations in Impedance Spectroscopy: Part I—Simulation of Reference Electrode Artifacts in Three-Point Measurements," *Solid State Ionics* **91**, 191–201 (1996).

G. Hsieh, T. O. Mason, and L. R. Pederson, "Experimental Limitations in Impedance Spectroscopy: Part II—Electrode Artifacts in Three-Point Measurements on Pt/YSZ," *Solid State Ionics* **91**, 203–12 (1996).

G. Hsieh, T. O. Mason, E. J. Garboczi, and L. R. Pederson, "Experimental Limitations in Impedance Spectroscopy: Part III—Effect of Reference Electrode Geometry Position," *Solid State Ionics* (1997) (in press).

J. W. Stevenson, T. R. Armstrong, R. D. Carneim, L. R. Pederson, and W. J. Weber, "Electrochemical Properties of Mixed Conducting Perovskites $\text{La}_{1-x}\text{M}_x\text{Co}_{1-y}\text{Fe}_y\text{O}_{3-d}$ ($\text{M} = \text{Sr}, \text{Ca}, \text{Ba}$)," *J. Electrochem. Soc.* **143**, 2722–29 (1996).

Papers in Conference Proceedings

T. R. Armstrong, J. L. Bates, L. A. Chick, G. D. Maupin, L. R. Pederson, P. J. Raney, J. W. Stevenson, and W. J. Weber. "Stability of Solid Oxide Fuel Cell Materials," p. 486 in *Proc. - US Russian Workshop on Fuel Cell Technologies*, SAND96-0945, Sandia National Laboratories, Albuquerque, N. M., 1996.

T. R. Armstrong, J. L. Bates, G. W. Coffey, L. R. Pederson, P. J. Raney, J. W. Stevenson, W. J. Weber, and F. Zheng. "Stability of Solid Oxide Fuel Cell Materials," pp. 301–10 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

T. R. Armstrong, J. W. Stevenson, and L. R. Pederson. "Dimensional Instability of Cathode and Interconnect Materials in Reducing Environments," p. 521 in *Proc. 2nd European SOFC Forum*, ed. B. Thorstensen (1996).

K. Breder and R. J. Parten, "Strength and Corrosion Behavior of SiC-Based Ceramics in Hot Coal Combustion Environments," pp. 53–62 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

K. Breder and J. R. Keiser, "Failure Analysis of an Alpha-SiC Tube Subjected to Thermal Cycling in an Oxygen-Steam Atmosphere," pp. 301–16 in *Proceedings of Fractography of Glasses and Ceramics III, Ceramics Transactions*, Vol. 64, ed. J. R. Varner, V. D. Frechette, and G. D. Quinn, The American Ceramic Society, Westerville, Ohio, 1996.

K. Breder, T. J. Mroz, A. A. Wereszczak, and V. J. Tennery, "Utilization of Fractography in the Evaluation of High-Temperature Dynamic Fatigue Experiments," pp. 353–66 in *Proceedings of Fractography of Glasses and Ceramics III, Ceramics Transactions*, Vol. 64, ed. J. R. Varner, V. D. Frechette, and G. D. Quinn, The American Ceramic Society, Westerville, Ohio, 1996.

L. R. Pederson, G. W. Coffey, J. L. Bates, and W. J. Weber. "Proton-Conducting Cerate Ceramics." pp. 311–18 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

J. W. Stevenson, T. R. Armstrong, B. L. Armstrong, J. L. Bates, G. Hsieh, L. R. Pederson, and W. J. Weber, "Mixed Oxygen Ion/Electron Conducting Ceramics for Oxygen Separation," pp. 117–26 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

J. W. Stevenson, T. R. Armstrong, J. L. Bates, L. R. Pederson, and W. J. Weber, "Electrochemical Properties of Mixed Conducting (La,M)(Co,Fe) Oxide Perovskites (M = Ca, Sr, and Ba)," p. 682 in *Proc. - US Russian Workshop on Fuel Cell Technologies*. SAND96-0945, Sandia National Laboratories, Albuquerque, N.M., 1996.

J. W. Stevenson, T. R. Armstrong, L. R. Pederson, and W. J. Weber, "Electrochemical Properties of Mixed Conducting $\text{La}_{1-x}\text{Mn}_x\text{Co}_{1-y}\text{Fe}_y\text{O}_3$ (M = Sr, Ca, Ba) Perovskites," pp. 94–105 in *Proc. 1st. Int. Symp. Ceramic Membranes*, ed. H. U. Anderson, A. C. Khandkar, and M. Liu, Electrochemical Society, Pennington, N.J., 1996.

J. W. Stevenson, T. R. Armstrong, W. J. Weber, and L. R. Pederson. "Processing and Properties of $\text{La}_{1-x}\text{Mn}_x\text{Co}_{1-y}\text{Fe}_y\text{O}_3$ (M = Sr, Ca) Perovskites," p. 59 in *Role of Ceramics in Advanced Electrochemical Devices, Ceramic Transactions 65*, American Ceramic Society, Cincinnati, 1996.

2.10 CERAMICS—CERAMIC FILTERS

Open Literature Publications

R. R. Judkins, D. P. Stinton, and J. H. DeVan, "A Review of the Efficacy of Silicon Carbide Hot Gas Filters in Coal Gasification and Pressurized Fluidized Bed Combustion Environments," *Journal of Engineering for Gas Turbines and Power, Transactions of the ASME* **118**, 500–506 (July 1996).

R. R. Judkins, D. P. Stinton, R. G. Smith, E. M. Fischer, H. H. Eaton, B. L. Weaver, J. L. Kahnke, and D. J. Pysher, "Development of Ceramic Composite Hot-Gas Filters," *Journal of Engineering for Gas Turbines and Power, Transactions of the ASME* **118**, 495–99 (July 1996).

Topical Reports

J.P. Hurley, *Support Services for Ceramic Fiber-Ceramic Matrix Composites*, ORNL/Sub/94-SS112V/01, Oak Ridge Natl. Lab., September 20, 1995.

J.P. Hurley and J. W. Nowok, *Support Services for Ceramic Fiber-Ceramic Matrix Composites*, ORNL/Sub/94-SS112V/02, Oak Ridge Natl. Lab., December 27, 1996.

Papers in Conference Proceedings

C.E. Crossland et al., "Thermochemistry of Corrosion of Ceramic Hot Gas Filters in Service," in *Proceedings of the Second International Workshop on Corrosion in Advanced Power Plants* at the Wyndham Harbour Island Hotel, Tampa, Florida, March 3–6, 1997, ed. Electric Power Research Institute, Inc., to be published in 1997.

C.E. Crossland, D. L. Shelleman, K. E. Spear, and R. E. Tressler, "High Temperature Corrosion of Advanced Ceramics Material for Hot-Gas Filters and Heat Exchangers," pp. 205–14 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

E. M. Fischer and R. G. Smith, "Performance of Ceramic Fiber Composite Hot Gas Filters," pp. 806–17 in *High Temperature Gas Cleaning, Karlsruhe, Germany, September 17–19, 1996*, ed. E. Schmidt, P. Gang, T. Pilz, A. Dittler, Institut für Mechanische Verfahrenstechnik und Mechanik, Universität Karlsruhe (TH), Karlsruhe, Germany, 1996.

J. P. Hurley, "Factors Affecting the Corrosion Rates of Ceramics in Coal Combustion Systems," pp. 57–69 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

J. P. Hurley and J. W. Nowok, "Conditions for Testing the Corrosion Rates of Ceramics in Coal Gasification Systems," pp. 181–91 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

R. R. Judkins, D. P. Stinton, and J. H. DeVan, "A Review of the Efficacy of Silicon Carbide Hot Gas Filters in Coal Gasification and Pressurized Fluidized Bed Combustion Environments," ASME Paper No. 94-GT-314, International Gas Turbine and Aeroengine Congress and Exposition, The Hague, The Netherlands, June 13–16, 1994.

R. R. Judkins, D. P. Stinton, R. G. Smith, and E. M. Fischer, "Ceramic Fiber Ceramic Matrix Filter Development," in *Proceedings of the Coal-Fired Power Systems 94—Advances in IGCC and PFBC Review Meeting*, Morgantown, West Virginia, June 22, 1994.

R. R. Judkins, D. P. Stinton, R. G. Smith, E. M. Fischer, H. H. Eaton, B. L. Weaver, J. L. Kahnke, and D. J. Pysher, "Development of Ceramic Composite Hot-Gas Filters," *International Gas Turbine and Aeroengine Congress and Exposition*, Houston, June 5–8, ASME Paper No. 95-GT-305, 1995.

E. R. Kupp, M. F. Trubelja, K. E. Spear, and R. E. Tressler, "High Temperature Corrosion of Advanced Ceramic Materials for Hot-Gas Filters and Heat Exchangers," pp. 117–26 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

D. J. Pysher, B. L. Weaver, R. G. Smith, J. H. Eaton, and J. L. Kahnke, "Mechanical Behavior of Ceramic Composite Hot-Gas Filters After Exposure to Severe Environments," pp. 97–106 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

J. P. Singh, S. Majumdar, M. Sutaria, and W. Bielke, "Fracture Behavior of Advanced Ceramic Hot-Gas Filters," pp. 193–204 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

J. P. Singh, D. Singh, J. Smith, and H. Volz, "Fracture Behavior of Advanced Ceramic Hot-Gas Filters," pp. 107–15 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

2.11 CERAMICS—CERAMIC MEMBRANES

Topical Reports

K. D. Adcock and G. E. Roettger, *Glass Glazing Ends of Porous Alumina Tubes*, K/TSO-32, Oak Ridge K-25 Site, Oak Ridge, Tennessee, August 1996.

G. E. Roettger and D. E. Fain, *Effects of Leaks on Gas Separation Performance of Nano Pore Size Membranes*, K/TSO-24, Oak Ridge K-25 Site, Oak Ridge, Tennessee, October 1996.

Papers in Conference Proceedings

D. E. Fain, "Inorganic Membranes: The New Industrial Revolution," pp. 365–79 in *Proceedings of the Third International Conference on Inorganic Membranes*, Worcester, Mass., July 10–14, 1994, ed. Yi Hua Ma, *Third International Conference on Inorganic Membranes*, Worcester Polytechnic Institute, 100 Institute Road, Worcester, Mass., 1995.

D. E. Fain and G. E. Roettger, "Ceramic Membrane for High Temperature Hydrogen Separation," pp. 107–16 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14–16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

D. E. Fain and G. E. Roettger, "High Temperature Inorganic Membranes for Separating Hydrogen," pp. 185–93 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16–18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

2.12 CARBON MATERIALS

Open Literature Publications

T. D. Burchell and R. R. Judkins, "Passive CO₂ Removal Using a Carbon Fiber Composite Molecular Sieve," *Journal of Energy Conversion and Management*, **37**(6-8), 947-54 (1996).

T. D. Burchell, R. R. Judkins, M. R. Rogers, and A. M. Williams, "A Novel Process and Material for the Separation of Carbon Dioxide and Hydrogen Sulfide," *Carbon* (in press).

F. Derbyshire, M. Jagtoyen, C. Lafferty, and G. Kimber, "Adsorption of Herbicides Using Activated Carbons," *Am.Chem. Soc. Div. of Fuel Chem. Preprints* **41**(1), 472-75 (1996).

Papers in Conference Proceedings

T. D. Burchell, "Carbon Materials for Advanced Energy Applications," p. 185 in *Proc. European Carbon Conference (Carbon '96)*, July 7-12th, Newcastle upon Tyne, England, the British Carbon Group, 1996.

T. D. Burchell, "A Monolithic Carbon-Fiber Based Composite Adsorbent," p. 749 in *Proc. European Carbon Conference (Carbon '96)*, July 7-12th, Newcastle upon Tyne, England, the British Carbon Group, 1996.

T. D. Burchell, and R. R. Judkins, "A Novel Carbon Fiber Based Material and Separation Technology," Third International Conference on Carbon Dioxide Removal, MIT, Cambridge, Mass., Sept. 9-11, 1996, *Energy Conv. & Management* (in press).

T. D. Burchell, R. R. Judkins, and M. R. Rogers, "A Novel Parametric Swing Process for the Separation of Hydrogen from Coke Oven Waste Gas," in *Proc. US/Japan Joint Technical Workshop on Coal Liquefaction and Materials for Coal Liquefaction*, State College, Penn., Sept. 30-Oct 2, 1996, U.S. Department of Energy, to be published in 1996.

T. D. Burchell, R. R. Judkins, M. R. Rogers, and A. M. Williams, "A Novel Approach to the Removal of CO₂," p. 135 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

T. D. Burchell, J. W. Klett, and C. E. Weaver, "A Novel Carbon Fiber Based Porous Carbon Monolith," pp. 447-56 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee*, Conf-9505204, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

M. Jagtoyen and F. Derbyshire, "Carbon-Fiber Composite Molecular Sieves for Gas Separation," pp. 291-300 in *Proceedings of the Tenth Annual Conference on Fossil Energy Materials, May 14-16, 1996, Knoxville, Tennessee*, comp. N. C. Cole and R. R. Judkins, Conf-9605167, ORNL/FMP-96/1, Oak Ridge Natl. Lab., Aug. 1996.

M. Jagtoyen, F. Derbyshire, G. Kimber, and Y. Q. Fei, "Carbon-Fiber Composite Molecular Sieves For Gas Separation," pp. 457-66 in *Proceedings of the Ninth Annual Conference on Fossil Energy Materials, May 16-18, 1995, Oak Ridge, Tennessee, Conf-9505204*, ORNL/FMP-95/1, Oak Ridge Natl. Lab., Aug. 1995.

M. Jagtoyen, F. Derbyshire, G. Kimber, and Y. Q. Fei, "Synthesis of Activated Carbons for Environmental Applications," *Florida Environmental Conference*, Palm Coast Florida, Nov. 1-4, 1995.

M. Jagtoyen, F. Derbyshire, G. Kimber, and I. M. Guillon, "Novel Activated Carbon Fiber Composites for Clean Air Applications," in *Proceedings of Clean Air '96*, Nov. 19-22, Orlando, Fla., 1996.

M. Jagtoyen, C. Lafferty, F. Derbyshire, and G. Kimber, "Adsorbent Carbon Composites for Water Treatment," pp. 41-42 in *Proceedings for the Kentucky Water Resources Annual Symposium*, Holiday Inn, Lexington, Ky., Feb. 13, 1996.

M. Jagtoyen, C. Lafferty, G. Kimber, and F. Derbyshire, "Adsorbent Carbon Fiber Composites For Water Treatment," pp. 328-29 in *Proc. European Carbon Conference (Carbon '96)*, July 7-12th, Newcastle upon Tyne, England, the British Carbon Group, 1996.

G.M. Kimber, Y. Q. Fei, M. Jagtoyen, and F. Derbyshire, "Coal Based Activated Carbon Fiber Composites for Gas Separation," 1157-60 in *Proceedings of the Eighth International Conference on Coal Science*, Vol. I, Oviedo, Asturias, Spain, ed. J. AS. Pajares and J. M. D. Tascón, Elsevier, 1995.

3. ENVIRONMENTAL ANALYSIS SUPPORT

3.1 ENVIRONMENTAL ASSESSMENTS AND IMPACTS

Topical Reports

R. L. Miller et al., *Environmental Assessment for the Warren Station Externally Fired Combined Cycle Demonstration Project*, DOE/EA-1007, U.S. Department of Energy, April 1995.

3.2 ENVIRONMENTAL ANALYSIS

Open Literature Publications

T. J. Blasing, R. L. Miller, and L. N. McCold, "Potential Consequences of the Clean Coal Program for Air and Waste Issues," *Air & Waste Manage. Assoc.* **46**, 517–29 (June 1996).

Topical Reports

R. L. Miller, *Environmental Analysis of the Tangentially-Fired Demonstration of Low-NO_x Technologies*, Oak Ridge Natl. Lab., U.S. DOE Pittsburgh Energy Technology Center, October 1995.

Papers in Conference Proceedings

L. W. Richards and R. L. Miller, "Analysis of the Potential for a Coal-Fired Power Plant to Cause Visibility Impairment in a National Park," in *The Air & Waste Management Association's 88th Annual Meeting & Exhibition, San Antonio, Texas, June 18–23, 1995*, 95-WP96.02, Air and Waste Management Association, Pittsburgh, 1995.

4. BIOPROCESSING RESEARCH

4.1 BIOPROCESSING RESEARCH

Open Literature Publications

E. N. Kaufman et al., "Development of an Electro-Spray Bioreactor for Crude Oil Processing," *Fuel Processing Technology*, 1997 (in press).

E. N. Kaufman and B. E. Dale, "Emerging Topics in Industrial Biotechnology," *Appl. Biochem. and Biotech.*, 1997 (in press).

E. N. Kaufman, M. H. Little, and P. T. Selvaraj, "A Biological Process for the Reclamation of FGD Gypsum Using Mixed Sulfate-Reducing Bacteria with Inexpensive Carbon Sources," *Appl. Biochem. and Biotech.*, 1997 (in press).

E. N. Kaufman, M. H. Little, and P. T. Selvaraj, "Recycling of FGD Gypsum to Calcium Carbonate and Elemental Sulfur Using Mixed Sulfate Reducing Bacteria with Sewage Digest as a Carbon Source," *J. Chem. Tech. and Biotechn.* **66**, 365-74().

E. N. Kaufman, J. N. Petersen, Y. Wang, and M. H. Little, "Experimental and Numerical Characterization of Liquid Fluidized Beds of Coal," *Chemical Engineering Science* **50**, 3703-14 (1995).

E. N. Kaufman, C.D. Scott, C.A. Woodward, and T. C. Scott, "Use of Modified Enzymes for the Solubilization/Liquefaction of Bituminous Coal in a Fluidized-Bed Reactor," *Appl. Biochem. and Biotech.* **54**, 233-48 (1995).

P. T. Selvaraj et al., "Biodesulfurization of Flue Gases Using Synthesis Gas Delivered as Microbubbles," *Amer. Chem. Soc.* (1997) (in press).

P. T. Selvaraj, M. H. Little, and E. N. Kaufman, "Analysis of Immobilized Cell Bioreactors for Desulfurization of Flue Gases and Sulfite/Sulfate Laden Waste Water," *Bioremediat.*, (1997) (in press).

P. T. Selvaraj, G. B. Meyer, and E. N. Kaufman, "Microbial Reduction of Sulfur Dioxide in Immobilized, Mixed Cultures of Sulfate Reducing Bacteria with Sewage Digest as Carbon and Energy Source," *Appl. Biochem. and Biotech.* **57/58**, 993-1002 (1996).

Y. Wang, J. N. Petersen, and E. N. Kaufman, "Modeling the Biological Solubilization of Coal in a Liquid Fluidized Bed Reactor," *Appl. Biochem. and Biotech.* **51**, 437-48 (1995).

W. Weigand and E. N. Kaufman, "Bioprocessing Research Overview," *Appl. Biochem. and Biotech.* **51**, 293 (1995).

C.A. Woodward and E. N. Kaufman, "Enzymatic Catalysis in Organic Solvents: Polyethylene Glycol Modified Hydrogenase Retains Sulfhydrogenase Activity in Toluene," *Biotechn. and Bioeng.* **52**, 423-28.

Books and Book Articles

E. N. Kaufman et al., "Enzymatic and Hydrodynamic Studies of a Liquid/Solid Fluidized-Bed Reactor for Coal Bioconversion," pp. 254–67 in *Minerals Bioprocessing II*, ed. D. S. Holmes and R. W. Smith, the Minerals, Metals, and Materials Society, Warrendale, Penn., 1995.

H. M. Lizama and E. N. Kaufman, "Biotreatment of H₂S in the Petroleum Industry," pp. 241–53 in *Minerals Bioprocessing II*, ed. D. S. Holmes and R. W. Smith, the Minerals, Metals, and Materials Society, Warrendale, Penn., 1995.

4.2 RENEWABLE HYDROGEN PRODUCTION

Open Literature Publications

E. Greenbaum, J. W. Lee, C. V. Tevault, S. L. Blankinship, and L. J. Mets, "CO₂ Fixation and Photoevolution of H₂ and O₂ in a Mutant of *Chlamydomonas* Lacking Photosystem I," *Nature* **376**, 438–41 (1995).

E. Greenbaum, J. W. Lee, C. V. Tevault, S. L. Blankinship, and L. J. Mets, "New Photosynthesis or Old?" *Nature* **379**, 304–5 (1996).

E. Greenbaum, C. V. Tevault, and C. Y. Ma, "New Photosynthesis: Direct Photoconversion of Biomass to Molecular Oxygen and Volatile Hydrocarbons," *Energy & Fuels* **9**, 163–67 (1995).

I. Lee, J. W. Lee, R. J. Warmack, D. P. Allison, and E. Greenbaum, "Molecular Electronics of a Single Photosystem I Reaction Center: Studies with Scanning Tunneling Microscopy and Spectroscopy," *Proc. Natl. Acad. Sci. USA* **92**, 1965–69 (1995).

J. W. Lee and E. Greenbaum, "Bioelectronics and Biometallocatalysis for Production of Fuels and Chemicals with Photosynthetic Water-Splitting," *Appl. Biochem. Biotechnol.* **51/52**, 295–305 (1995).

J. W. Lee, S. L. Blankinship, and E. Greenbaum, "Temperature Effect on Production of Hydrogen and Oxygen by *Chlamydomonas* Cold Strain CCMP1619 and Wild Type 137c," *Appl. Biochem. Biotechnol.* **51/52**, 379–86 (1995).

J. W. Lee, I. Lee, and E. Greenbaum, "Platinization: A Novel Technique to Anchor Photosystem I Particles onto a Metal Surface at Biological Temperature and pH," *Biosens. Bioelectron.* **11**, 375–87 (1996).

J. W. Lee, I. Lee, P. D. Laible, T. G. Owens, and E. Greenbaum, "Chemical Platinization and its Effect on Excitation Transfer Dynamics and P700 Photooxidation Kinetics in Isolated Photosystem I," *Biophys. J.* **69**, 652–59 (1995).

J. W. Lee, C. V. Tevault, T. G. Owens, and E. Greenbaum, "Oxygenic Photoautotrophic Growth Without Photosystem I" *Science* **273**, 364–67 (1996).

Books and Book Articles

E. Greenbaum, "Biomolecular Electronics and Applications," pp. 98–103 in *Encyclopedia of Molecular Biology and Biotechnology, A Comprehensive Desk Reference*, ed. R. A. Meyers, VCH Publishers, 1995.

E. Greenbaum, "Biomolecular Electronics and Applications," pp. 148–59 in *Encyclopedia of Molecular Biology and Molecular Medicine*, Vol. 1, VCH Publishers, 1996.

4.3 BIOREMEDIATION

Topical Reports

G. W. Suter II, *A Framework for Assessing Ecological Risks of Petroleum-Derived Materials in Soil*, Oak Ridge Natl. Lab. (in press).

5. FOSSIL FUELS SUPPLIES MODELING AND RESEARCH

5.1 FOSSIL FUELS RESOURCE EVALUATION

Open Literature Publications

J. Barhen, V. Protopopescu, and D. Reister, "TRUST: A Deterministic Global Optimization Algorithm," *Science*, January (1997) (in press).

Papers in Conference Proceedings

C. Glover, F. Aminzadeh, J. Barhen, and N. Toomarian, "Neural Network Accuracy Measures and Data Transforms Applied to the Seismic Parameter Estimation Problem," *Proc. Third International Conference on Neural Networks and their Applications*, Marseille, France, March 1997.

N. Toomarian, J. Barhen, C. Glover, and F. Aminzadeh, "Oil Reservoir Properties Estimation using Neural Networks," *Proc. Third International Conference on Neural Networks and their Applications*, Marseille, France, March 1997.

6. ADVANCED TURBINE SYSTEMS

6.1 MATERIALS AND MANUFACTURING ELEMENT

Papers in Conference Proceedings

C. Alsup, C. Zeh, S. Blazewicz, "Proceedings of the Advanced Turbine Systems Annual Program Review," *ATS Annual Review*, Morgantown, W. Va., October 17-19, 1995.

C. S. Kortovich, R. G. Garloc, and C. R. Hayes, "Turbine Airfoil Manufacturing Technology," ASME paper No. 97-GT-428, presented at the *42nd ASME Gas Turbine and Aeroengine Congress, Exposition and Users Symposium*, Orlando, Fla., June 2-5, 1997.

A. Layne and P. Hoffman, "Proceedings of the Advanced Turbine Systems Annual Program Review," *ATS Annual Review*, Washington, DC, November 7-8, 1996.

B. A. Mueller, A. R. Price, K. S. Murphy, and G. B. Bell, "Land-Based Turbine Casting Initiative," ASME paper No. 97-GT-430, presented at the *42nd ASME Gas Turbine and Aeroengine Congress, Exposition and Users Symposium*, Orlando, Fla., June 2-5, 1997.

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