David W. Richerson Curriculum Vitae

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EMPLOYMENT

University of Utah 1991- present, Adjunct Associate Professor.

- Have taught Advanced Composites, Introduction to Ceramics, Mechanical Properties of Solids, Case Studies in Materials Science and Engineering, Materials Molding Civilization, and been coordinator for Senior Thesis/Senior Project.
- Have participated on the Recruiting and Outreach Committee and on the ABET Accreditation Committee.
- Involved in the NSF-funded UTES project to study and model air quality in the Salt Lake Valley, especially to provide energy inputs (such as scenarios of advanced technologies increasing energy efficiency and reducing pollution) and to support community outreach planning and efforts (see details under Education and Service).
- PI on the NSF program "Materials and Engineering for a Sustainable Future".
- Proposal organizer and Program Manager for the $2 million 5-year NSF program "Utah's Engineers: a Statewide Initiative for Growth".

Richerson and Associates 1991- present, President.

- Consulted continuously with Department of Energy and Oak Ridge National Laboratory from 1992-2003 on advanced materials development/characterization (silicon nitride and silicon carbide, ceramic matrix composites, and low thermal expansion ceramics) and the application of these materials to automobiles, gas turbine engines, fuel cells and other devices for increasing energy efficiency and reducing pollution. Also conducted a study on the potential applications of ceramics and composites to reduce pollution and increase energy efficiency in the Industries of the Future (forest products, chemicals, petroleum, aluminum, metals casting, steel, glass).
- Consulted with Solar Turbines, Inc. from 1991-2001 prior to and during their Ceramic Stationary Gas Turbine program. Participated on the design, materials, and test teams and especially was involved in ceramic and composite materials qualification and post-test evaluation (such as failure analysis).
- Consulted intermittently with a variety of other companies (including Advanced Ceramics Research, Ceramatec, General Electric, Dow Corning, Hexcel, and Saint-Gobain Norton Advanced Ceramics).

Advanced Energy Devices 1995-1999, Co-founder and Vice President

- Designed a residential hybrid solid oxide fuel cell system

- Prepared a study and a business plan and influenced the thinking and program strategy of utilities and the Government regarding development of fuel cells.

Ceramatec, Inc., Salt Lake City Utah 1985-1991, initially Director of R&D, later Vice President.

- Assembled and directed a R&D team that developed world-class technology in electrochemistry, silicon carbide, zirconium oxide, aluminum nitride, solid oxide fuel cells, and ceramic matrix composites. In less than five years increased funded R&D programs from $850K to $3.4 million per year.
- As Ceramatec evolved into a company focused on electrochemical devices, the R&D group dispersed and the various individuals started a number of companies: Beta Power, Advanced Ceramics Research, Lone Peak Engineering, Triox Technologies, and LoTec (low thermal expansion ceramics).

Garrett Turbine Engine Company, Phoenix, AZ (later became Allied-Signal Engines and presently Honeywell Engines and Systems) 1973-1985, initially Senior Research Engineer, later Supervisor Advanced Materials.

- Hired to build a ceramic materials program and establish Garrett Turbine Engine Company as a world leader in the use of ceramics in gas turbine engines.
- Proposed, planned, and coordinated ceramics activities on numerous funded (DARPA, NASA, Air Force, Navy, Army, DOE) and in-house programs including monolithic and composite ceramics processing development and characterization, turbine engine component design and life prediction, NDE development, contact stress and oxidation/corrosion research, rig and engine test support, and failure analysis.
- Worked closely with ceramic development companies to improve the high temperature properties of silicon nitride and silicon carbide and also helped plan and establish an in-house ceramic fabrication facility that ultimately became Honeywell Ceramic Components.
- Pioneered the following: (1) conducting burner rig exposures on flexure strength test bars and measuring post-test strength, rather than just measuring weight change (2) use of fractography of ceramics to understand engine failures, (3) development of test apparatus and procedures to study and understand contact stress, (4) application of oxide coatings to silicon-based ceramics.
- At the request of the ASME Ceramics Committee, prepared a white paper outlining the supporting technologies work that needed to be conducted in ceramics development, design and life prediction, NDE and other areas before ceramics could be successful in gas turbine engines. This document was used as the model by DOE and ORNL for their Ceramic Technology for Advanced Heat Engines program from 1983-1996. Was invited to ORNL for 9 days to help them (Tony Schaffhauser and Ernie Long) put together the comprehensive program.

Arizona State University, Tempe, AZ 1979-1985, Adjunct Faculty, taught classes on structural ceramics. Wrote the first edition of Modern Ceramic Engineering.

Norton Company, Worcester, MA 1969-1973, started as Research Engineer and promoted to Senior Research Engineer.

- Initially conducted R&D on boron carbide ceramic armor, ceramic dies for extrusion of stainless steel, alumina with metal screen reinforcement, and wear-resistant polyurethane/ceramic composites.
- Led the effort to develop and commercialize hot pressed silicon nitride, including development of the NC-132 material that became the world standard throughout the 1970s and is still used as a standard at NIST. Pioneered the concept of "grain boundary engineering" and achieved a three-fold improvement in the high temperature strength of hot pressed silicon nitride and a five-fold increase in oxidation resistance and stress rupture life.
- An early pioneer in the use of SEM to understand the correlation between microstructure, flaws, processing and properties of ceramic materials and to subsequently improve the properties of the materials. Demonstrated in 1972 an experimental hot pressed silicon nitride material with an average 4-point bend strength of 1 GPa,, peak values over 1.1 GPa, and minimum value of 0.83 GPa (120,000 psi). Previous HPSN materials had minimum values typically around 0.5 GPa or less and average of about 0.8 GPa.

Tektronix, Inc., Beaverton, OR summers of 1966 and 1967 while still a student at the University of Utah.

EDUCATION

Pennsylvania State University, State College, PA 1967-1969

- Worked under Dr. Floyd Hummel on low thermal expansion ceramics
- Received the degree of Master of Science in Ceramic Science and Engineering.

University of Utah, Salt Lake City, UT 1962-1967

- Studied under Dr. Ivan Cutler
- Received the BS degree in Ceramic Science and Engineering

PUBLICATIONS

Books Authored or Co-Authored

1. D. W. Richerson, *Modern Ceramic Engineering: Properties, Processing, and Use in Design*, *3rd* Edition, CRC Press, Boca Raton, Florida, 2006.
2. D. W. Richerson, *The Magic of Ceramics*, The American Ceramic Society, Westerville, OH, 2000.
3. D. W. Richerson, *Modern Ceramic Engineering: Properties, Processing, and Use in Design, 2nd Edition*, Marcel Dekker, Inc., New York, 1992.
4. E. Ryshkewitch and D. W. Richerson, *Oxide Ceramics, 2nd Edition*, General Ceramics, Inc., Haskell, N.J. and Academic Press, Orlando, FL, 1985.
5. D. W. Richerson, *Modern Ceramic Engineering*, in Japanese, Uchida Rokakuho Publishing Co., Ltd., Tokyo, Japan.

6. D. W. Richerson, *Modern Ceramic Engineering: Properties, Processing, and Use in Design*, Marcel Dekker, Inc., New York, 1982.

Books Edited or Co-Edited

1. M. van Roode, M. Ferber, and D.W. Richerson, *Ceramic Gas Turbine Component Development and Characterization*, ASME Press, New York, 2003.
2. M. van Roode, M. Ferber, and D. W. Richerson, Editors, *Ceramic Gas Turbine Design and Test Experience*, ASME Press, New York, 2002.
3. D. C. Cranmer and D. W. Richerson, Editors, *Mechanical Testing Methodology for Ceramic Design and Reliability*, Marcel Dekker, Inc., New York, 1998.
4. D. W. Richerson, Editor, *Ceramics Applications in Manufacturing*, Society of Manufacturing Engineers, Dearborn, MI, 1988.

Book Chapters

1. D.W. Richerson, "Advanced Ceramic Materials", Chapter 2 in *The Handbook of Advanced Materials-Enabling New Designs*, James K. Wessel, Editor, Wiley-Interscience, New York, 2004.
2. D.W. Richerson, T. Iseki, A.V. Soudarev, and M. van Roode, "An Overview of Ceramic Materials Development and Other Supporting Technologies," Chapter 1 in *Ceramic Gas Turbine Component Development And Characterization*, edited by M. van Roode, M.K. Ferber, and D.W. Richerson, ASME Press, New York, 2003, pp. 1-30.
3. D.W. Richerson, E. Bright, and R. Licht, "Ceramic Component Development at Saint-Gobain/Norton Advanced Ceramics," *ibid*, Ch. 3, pp. 55-76.
4. D.W. Richerson, M.K. Ferber, and M. van Roode, "The Ceramic Gas Turbine---Retrospective, Current Status and Prognosis," *ibid*, Ch. 29, pp. 693-742.
5. D. Anson and D. W. Richerson, "The Benefits and Challenges of the Use of Ceramics in Gas Turbines", Chapter 1 in *Ceramic Gas Turbine Design and Test Experience*, edited by M. van Roode, M. K. Ferber, and D. W. Richerson, ASME Press, New York, 2002, pp. 1-10.
6. D. W. Richerson and D. Anson, "Evolution of Ceramic Gas Turbine Development Programs at Engine Manufacturers in the United States," *ibid*, Ch. 2, pp. 11-16.
7. B. Schenk, M. L. Easley, and D. W. Richerson, "Evolution of Ceramic Turbine Engine Technology at Honeywell Engines, Systems, and Services", ibid, Ch. 4 , pp. 77-110.
8. D. W. Richerson, "Industrial Applications of Ceramic Matrix Composites", in *Comprehensive Composites*, Elsevier, London, 2000.
9. D. W. Richerson, "Testing for Design, Material, and Fabrication Optimization", Chapter 9 in *Mechanical Testing Methodology for Ceramic Design and Reliability*, edited by D. C. Cranmer and D. W. Richerson, Marcel Dekker, Inc., New York, 1998.

10. D. W. Richerson, "Ceramic Matrix Composites", Chapter 19 in *Composite Engineering Handbook*, edited by P.K. Mallick, Marcel Dekker, Inc., New York, 1997.
11. D. W. Richerson and P. Stephan, "Evolution of Applications of Silicon-Nitride-Based Materials", in *Preparation and Properties of Silicon Nitride Based Materials, Vol. 46, Materials Science Forum*, Trans Tech Publications, Switzerland, 1989.
12. D.W. Richerson, "Failure Analysis of Ceramics", pages 744-757 in Metals Handbook, Vol. 11: Failure Analysis and Prevention, ASM Int., Metals Park, OH, 1986.
13. R. N. Katz, W. Duckworth, and D. W. Richerson, "Nonvitreous Ceramics", Chapter 14 in *Materials and Processes, 3rd Edition*, edited by James F. Young and Robert S. Shane, Marcel Dekker, Inc., 1985.
14. D. W. Richerson, "Processing Ceramics", Chapter 28 in *Materials and Processes, 3rd Edition*.

Government Reports

1. "Advanced Ceramics Technology Roadmap", prepared by Richerson and Associates and Energetics, Inc. for Department of Energy and the United States Advanced Ceramic Association, December 2000.
2. D. W. Richerson, "The Status of Ceramic Turbine Component Fabrication and Quality Assurance Relevant to Automotive Turbine Needs", Final Report, ORNL/TM-1999/240, February 2000.
3. "Continuous Fiber Ceramic Composite Program Plan Update: Executive Summary, Accomplishments, and Program Completion Roadmaps", compiled by D. W. Richerson for DOE Office of Industrial Technologies, 1999.
4. D. W. Freitag and D. W. Richerson, "Opportunities for Advanced Ceramics to Meet the Needs of the Industries of the Future", DOE/ORO 2076, December 1998.
5. D.W. Richerson, prepared for the Department of Energy a detailed summary of the Phase I progress and accomplishments of the Continuous Fiber Ceramic Composites program and an assessment of the of the materials capabilities versus application requirements for each application under evaluation by each contractor, 1994.
6. "Japanese Structural Ceramics Research and Development", J. B. Wachtman, R.C. Bradt, R.F. Davis, R. Raj, D.W. Richerson, and N.J. Tighe, study conducted for the Foreign Applied Sciences Assessment Center, July 1989 (D. Richerson conducted the studies on silicon nitride and zirconium oxide).
7. C.W. Griffin, A. Hurford, D.W. Richerson, and A. Virkar, "Fabrication and Characterization of Ceramic Matrix – Ceramic Whisker Composites", Final Report under DOE SBIR Contract DE-AC02-85ER80281, August, 1989.
8. D. W. Richerson, "Fractography of Advanced Silicon Nitride Materials for Turbine Applications", Final Report Naval Sea Systems Command Contract N00024-88-C-5112, April, 1989.

9. D.W. Richerson and C. W. Griffin, “Fabrication and Characterization of Ceramic Matrix – Ceramic Whisker Composites with Random Orientation of the Whiskers”, Final Report under DOE SBIR Contract DE-AC02-85ER80281, 1989.
10. D. W. Richerson, K.L. Stuffle, and C.W. Griffin, “Hypersonic Ramjet Leading Edge Materials Development”, Final Report under Naval Surface Warfare Center Contract N60921-88-C-0109, October 1988.
11. D. W. Richerson, “High Thermal Conductivity Dispersion-Strengthened Silicon Nitride”, Final Report DOE SBIR ER 80367, March 1987.
12. A. Khandkar, D.W. Richerson, and L.G. Marianowski, “Development of Metal-Coated Ceramic Anodes for Molten Carbonate Fuel Cells”, Annual Report under DOE/METC Contract DE-AC21-85MC22194, September 1986.
13. D.W. Richerson, “Design, Processing Development and Manufacturing Requirements of Ceramics and Ceramic Matrix Composites”, 108 page report prepared for the Office of Technology Assessment, Congress of the United States under contract 533-6050.0, December 19, 1985.
14. Member of the National Materials Advisory Board Committee “Tribology of Ceramics” and participated in preparation of the report, 1985.
15. D.W. Richerson, A. Joshi, and J. Nachlas, “An Alternate Method for the Removal of Oxides of Nitrogen and Sulfur from Combustion Processes”, Interim report under DOE/PETC Contract DE-AC22-85PC81003, December 1985.
16. D.W. Richerson and J.R. Smyth, “Low Cost, Net-shape Ceramic Radial Turbine Program”, Final Report, AMMRC TR 85-2, May 1985.
17. L. Viswanathan and D.W. Richerson, “Whisker-Reinforced Boron Carbide Composite”, Final Report, ARO Contract DAAG 29-85-C-0015, November 1985.
18. W.D. Carruthers, D.W. Richerson, and K.W. Benn, “3500-Hour Durability Testing of Commercial Ceramic Materials,,” Interim Report under DOE/NASA Contract DEN3-27, DOE/NASA/0027-80/1, NASA CR-159785, July 1980.
19. D.W. Richerson and K. M. Johansen, “Ceramic Gas Turbine Engine Demonstration Program”, Final Report under DARPA/Navy Contract N00024-76-C-5352, May 1982.
20. K.M. Johansen, D.W. Richerson, and J.J. Schuldies, “Ceramic Components for Turbine Engines”, Phase II Technical Report for Air Force Contract F33615-77-C-5171, February 1980.
21. Committee member and co-author of “Reliability of Ceramics for Heat Engine Applications”, study conducted for the National Materials Advisory Board, Publication NMAB-357, National Academy of Sciences, 1980.

Technical Papers in Journals, Proceedings, Etc.

1. D.W. Richerson, “Materials Science and Engineering: a Rewarding Career”, Am. Ceram. Soc. Bull. **86** [10] 35-43 (2007).
2. D. W. Richerson, “Enhancing Science Learning Experiences in Elementary Schools”, Am. Ceram. Soc. Bull. **86** [10] 31-34 (2007).

3. D. W. Richerson, "Fuel Cells, Has Their Time Finally Come?", invited paper at the 1st International Ceramics Congress, Toronto, Canada, June 27, 2006, to appear in proceedings.
4. D. W. Richerson "Historical Review or Addressing the Challenges of Use of Ceramic Components in Gas Turbine Engines", , ASME Paper GT-2006-90330 presented at the ASME International Gas Turbine Conference, Barcelona, Spain, May 2006 (invited paper).
5. D. W. Richerson, "Ceramic Components in Gas Turbine Engines: Why Has it Taken So Long?", *Ceram. Eng. Sci. Proc.* **25** [3] 3-32, 2004 (invited paper).
6. M. van Roode, J.R. Price, V. Parthasarathy, D.W. Richerson, and G.A. Graves, "Ceramic Stationary Gas Turbine Program – Monolithic Ceramic Component Development Summary", ASME Paper 2001-GT-457, Presented at the International Gas Turbine & Aeroengine Congress and Exhibition, New Orleans, LA, June 4-7, 2001.
7. D.W. Richerson, "Ceramics for Turbine Engines", Mech. Eng., September, 1997.
8. D.W. Richerson, "The American Ceramic Education Programs", in Proc. of the Innovative Ideas in Ceramics and Materials Curriculum Symposium, American Ceramic Society, 1996.
9. D.W. Richerson, "Materials Science and Technology – Precollege Curricula", Bull. Am. Ceram.Soc. 70 [7] 794-95 (1991).
10. D.W. Richerson, "Silicon Nitride Structural Ceramics", pp. 161-205 in Japanese/American Technological Innovations, Ed. by W. D. Kingery, Elsevier, New York, 1991.
11. C.W. Griffin, S.Y. Limaye, D.W. Richerson, and D.K. Shetty, "Correleation of Interfacial and Bulk Properties of SiC-Monofilament-Reinforced Sodium Zirconium Phosphate Composites", Ceram. Eng. Sci. Proc. 11 [9-10] 1577-91, (1990).
12. D.W. Richerson, K. Stuffle, C. Griffin, and C. Martin, "Development of Continuous fiber Reinforced Group IV-B Diboride Composites", Proc. NASA/DOD Composites Meeting, Cocoa Beach, FL, Jan. 19-21, 1989.
13. C.W. Griffin, A.C. Hurford, A.V. Virkar, and D.W. Richerson, "Properties of Pressureless Sintered Alumina Matrix Composites Containing up to 30 vol% SiC whiskers", Cer. Eng. Sci. Proc. 10 [7-8] 685-706 (1989).
14. C.W. Griffin, D.W. Richerson, and D.K. Shetty, "Evaluation of Interfacial Properties in Borosilicate-SiC Composites Using Pullout Tests", Cer. Eng. Sci. Proc. 9 [7-8] 671-78 (1988).
15. J. Kertesz, R.J. Pryor, D.W. Richerson, and R. Cutler, "Machining Titanium Alloys with Ceramic Tools", J. of Metals, May 1988, p.50.
16. D.W. Richerson, "The Challenge of Fabrication of High Strength Complex Shape Ceramic Components", Keynote address, pages 1-88 in Transactions of the Third Canadian University-Industry Council on Advanced Ceramics Workshop, Edited by P.S. Nicholson, McMasters University, Ontario, Canada, Feb. 24-25, 1987.
17. D.W. Richerson and R. Vallee, "Role of Ceramics in the Future of Manufacturing", ASME Tech. Paper EM87-110 (1987); also reprinted as pages 3-11 in Ceramics Applications in Manufacturing, edited by D.W. Richerson, SME, Dearborn, MI, 1988.

18. D.W. Richerson, “Processing, Microstructure, Properties Relationship for Automotive Structural Ceramics”, Cer. Eng. Sci. Proc. 7 [9-10] 1122-34 (1986)
19. R. Cutler and D.W. Richerson, Advanced Silicon Nitride and Silicon Carbide Alloy Systems,” Proc. of the Dec. 1986 Electrochemical Society Meeting, Boston, MA.
20. B.J. McEntire, L. Viswanathan, A. Virkar, D.W. Richerson, and R. Gordon., “Development of Beta”-Alumina Electrolyte”, Proc. 7th Battery & Electrochemical Contractors Conf., held Nov. 18-21, 1985 in Washington D.C.
21. D.W. Richerson, “Evolution in the U.S. of Ceramic Technology for Turbine Engines”, Bull. Am. Ceram. Soc. 64 [2] 282-286 (1985).
22. D.W. Richerson and J. Schienle, “High Temperature Coatings Study to Reduce Contact Stress Damage of Ceramics”, Proc. 22nd Automotive Technology Development Contractors Coordination Meeting, P-155, ISBNO-89883-716-2, Published by SAE (1985).
23. L.J. Lindberg and D.W. Richerson, “Comparison of the Contact Stress and Friction Behavior of SiC and Zirconia Materials”, Cer. Eng. Sci. Proc. 6 [7-8] 1059-66 (1985).
24. D.W. Richerson, “Contact Stress at Ceramic Interfaces”, pp. 657—66 in Progress in Nitrogen Ceramics, edited by F.L. Riley, Martinus Nijhoff Publishers, The Hague, 1993.
25. D.W. Richerson, J. R. Smyth and K. H. Styhr, “Materials Improvement Through Iterative Process Development”, Cer. Eng. Sci. Proc. 4 [9-10] 841-52 (1983).
26. J.R. Smyth and D.W. Richerson, “High Temperature Dynamic Contact Behavior of Alpha SiC”, Cer. Eng. And Sci. Proc. 4 [7-8] 663-73 (1983).
27. D.W. Richerson and J.M. Wimmer, “Properties of Isostatically Hot Pressed Silicon Nitride”, J. Amer. Cer. Soc. 66 [9] C173-C176 (1983).
28. D.W. Richerson, “Oxidation Protection for Carbon-Carbon Composites”, pp.89-125 in Environmental Resistance of Carbon-Carbon Composites in Gas Turbine Engines, IDA Record document D-14, edited by T.F. Kearns, August 1983.
29. W.D. Carruthers and D.W. Richerson, “Combustor Rig Durability Testing of Ceramics”, pp. 571-96 in Ceramics for High Performance Applications III – Reliability, edited by E.M. Lenoe, R.N. Katz and J.J. Burke, Plenum Press, New York, 1983.
30. D.W. Richerson, J.M. Wimmer, and S.M. Wander, “Ceramic Technology Requirements for 1425 C (2600 F) Uncooled Power Generation Application”, IBID, pp. 217-234.
31. D.W. Richerson, D. Finger, and J. Wimmer, “Analytical and Experimental Evaluation of Biaxial Contact Stress”, in Fracture Mechanics of Ceramics, Vol. 5, edited by R.C. Bradt et. al., Plenum Press, 1983.
32. D.W. Richerson, “Ceramic Interface Considerations”, in the Summary of the Workshop on Ceramic Attachments for Industrial Heat Exchangers and Heat Engine Applications, edited by J.A. Carpenter, ORNL, Fall 1982.
33. D.W. Richerson, “Contact Damage in Ceramic Turbine Components – High Temperature Studies of Interface Friction and Contact Stress”, in Proc. of the ONR/NBS Workshop on Contact Damage in Ceramic Materials at Elevated Temperatures, edited by S. M. Wiederhorn, NBS, April, 1982.

34. D.W. Richerson, "What Are Ceramics", Chem. Eng. Sept. 20, 1982, pp 123-126; reprinted in Ceramic Applications in Manufacturing, pp. 12-14, edited by D.W. Richerson, SME, Dearborn, MI, 1988.
35. J. Wimmer and D.W. Richerson, "Ceramic Component Development for Limited-Life Engines", AIAA Paper AIAA-82-1050, presented at the AIAA/SAE/ASME 18th Joint Propulsion Conference, June 21-23, 1982.
36. L.J. Lindberg, D.W. Richerson, W.D. Carruthers, and H.M. Gersch, "Oxidation Stability of Advanced Reaction-Bonded Silicon Nitride Materials", Bull. Amer. Ceram. Soc. 61 [5] 574-78 (1982).
37. D.W. Richerson, K.M. Johansen, P.M. Ardans, and K.P. Johnson, "Cyclic Rig and Engine Testing of Ceramic Turbine Components", Cer. Sci. Eng. Proc. 3 [9-10] 620-29 (1982).
38. D.W. Richerson, "Applications of Modern Ceramic Engineering", Mech. Eng., December 1982; also reprinted as pages 201-209 in *Ceramic Applications in Manufacturing*, edited by D.W. Richerson, SME, Dearborn, MI, 1988.
39. D.W. Richerson, W.D. Carruthers, and L.J. Lindberg, "Contact Stress and Coefficient of Friction Effects on Ceramic Interfaces", pp. 661-676 in Materials Science Research, Vol. 14 – Surfaces and Interfaces in Ceramic and Ceramic-Metal Systems, edited by J. Pask and A. Evans, Plenum Press, 1981.
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43. D.W. Richerson, "Ceramic Design Requirements for Long-Life Heat Engines", in Proc. Workshop on Time Dependent Fracture of Materials at Elevated Temperature, edited by S. Wolf, NTIS, Springfield, VA (1979).
44. D.W. Richerson, "Materials Characterization Program Overview", pp. 187-191 in Proc. 1977 DARPA/NAVSEA Ceramic Gas Turbine Demonstration Engine Program Review, edited by J.W. Fairbanks and R.W. Rice, MCIC-78-36, Published by Metals and Ceramics Information Center, Battelle, Columbus, OH, 1978.
45. D.W. Richerson, T.M. Yonushonis, and G.Q. Weaver, "Properties of Silicon Nitride Rotor Blade Materials", *ibid*,. pages 193-217.
46. T.M. Yonushonis and D.W. Richerson, "Strength of Reaction Bonded Silicon Nitride", *ibid.*, pages 219-233.
47. D.W. Richerson and T.M. Yonushonis, "Environmental Effects on the Strength of Silicon Nitride Materials", *ibid.*, pages 247-271.
48. M.W. Robare and D.W. Richerson, "Rotor Blade Machining Development", *ibid.*, 291-311.
49. J.J. Schuldies and D.W. Richerson, "NDE Approach, Philosophy and Standards for the ARPA/NAVSEA Ceramic Turbine Program", *ibid.*, pages 381-402.

50. D.W. Richerson, J.J. Schuldies, T.M. Yonushonis, and K.M. Johansen, "ARPA/NAVY Ceramic Engine Materials and Process Development Summary", pp.625-650 in Ceramics for High Performance Applications – II, edited by J.J. Burke, E.N. Lenoe, and R.N. Katz, Brook Hill Publishing, Chestnut Hill, MA, 1978.
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52. A.G. Evans, L.R. Russell, and D.W. Richerson, "Slow Crack Growth in Ceramic Materials at Elevated Temperature", Met. Trans., Vol 6A, 707-16,April 1975.
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61. D.W. Richerson, "Testing and Selecting Wear Resistant Materials", Materials Eng. 75 [1] 46-49 (1972).
62. W.M.Wheildon, H.E.R. Brown, and D.W. Richerson, "High Hot Strength Ceramics for Metalworking Tools", ASM Metalworking Forum, Tooling Materials for Nonferrous Hot Extrusion, May 23-24, 1972.
63. M. Whieldon and D.W. Richerson, "Properties of Hot Pressed Silicon Nitride", Proc. 11th Symposium on Electromagnetic Windows, August 2-4, 1972.

Patents

1. D.W. Richerson and M.E. Washburn, "Hot Pressed Silicon Nitride", U.S. Patent 3,836,374, Sept. 17, 1974.

2. D.W. Richerson, "Hot Pressed Silicon Nitride Containing Finely Dispersed Silicon Carbide or Silicon aluminum Oxynitride", U.S. Patent 3,890,250, June 17, 1975.
3. D.W. Richerson and G.Q. Weaver, "Composite Ceramic Heating Element", U.S. Patent 3,895,219, July 15, 1975.
4. M.L. Torti and D.W. Richerson, "High Strength Composite Ceramic Structure", U.S. Patent 3,911,188, October 7, 1975.
5. D.W. Richerson and D.R. Schuyler, "Ceramic Composition and Crucibles and Molds Formed Therefrom", U.S. Patent 4,040,845, Aug. 9, 1977.

HONORS

1. Received the Admiral Ralph Earle Award from the Worcester Engineering Society in 1973 for "work in the field of ceramics".
2. Selected for membership on the National Materials Advisory Board committees "Reliability of Ceramics for Heat Engines" and "Tribology of Ceramics".
3. Selected by the Office of Technology Assessment, U.S. Congress to participate in an assessment projecting ceramics ttechnology potential and requirements from 1985 to 2010.
4. Selected to participate in the study "Japanese Structural Ceramics Research and Development" by the Foreign Applied Sciences Assessment Center.
5. Fellow of the American Ceramic Society
6. Elected to the Board of Directors of the American Ceramic Society, 2000-2003.
7. Selected to present the 2007 Friedberg Lecture at the annual meeting of the American Ceramic Society
8. Invited in 2008 to be the Guest Curator of Minerals for the Utah Museum of Natural History

EDUCATION AND SERVICE OUTREACH

1. Has taught short courses (2-day to 4-day) on "Structural Ceramics", High Performance Ceramics", "Composites", "Processing of Ceramics", and other topics for the American Ceramic Society, AIChE, ASM, and CEI Europe and has also taught short courses at NASA, ORNL, MTEC (Bangkok, Thailand), Northwestern Technical University (Xian China), Sherritt Gordon, Johnson and Johnson, Saint-Gobain, Ceradyne, Ceramatec, and Advanced Ceramics Research.
2. Has presented many lectures on advanced ceramics, composites, and turbine engines worldwide.
3. Prepared a 14-lesson home study course on ceramics for ASM, International.
4. Requested in 1991 to establish an Education Committee for the American Ceramic Society and subsequently guided this committee from 1991 to 2001 as its Chair. Initiated and/or guided many projects including the Ceramic Demonstration Kit, outreach at schools, the traveling museum exhibit Magic of Ceramics that toured the U.S for two years, and preparation of the outreach book *The Magic of Ceramics*.

5. Conducts presentations and demonstrations in schools and at service organizations to encourage science literacy. Topics include ceramics, the role of materials in history, rocks and minerals, paleontology, and insects in amber. Currently visiting about 20 4th grade classes per year for about 2 hours each to conduct modules on rocks, minerals, and fossils.
6. During the early 1990s helped to organize the Utah Alliance for Science, Math and Technology Education and selected as Vice President and a member of the Steering Committee.
7. Prepared and teaches a course Materials Molding Civilization at the U. of Utah to the non-science majors to introduce these students to science, materials, and key issues that humans have had to address throughout history (including energy and pollution issues today).
8. Organized one class of U. of Utah students to conduct a study on global warming and to present the results to community leaders at the Mayor's office.
9. Has taught a course at the Utah Museum of Natural History on insects in amber.
10. Worked with the education staff at the North American Museum of Ancient Life to prepare an exhibit on insects in amber.
11. Coordinated outreach with K-12 classes in conjunction with the NSF program Urban Trace-Gas Emissions Study. Prepared four modules on energy and air pollution, established community partnerships, presented professional development workshops to 5th, 6th and 8th grade teachers, and implemented the modules during the 2004-2005, 2005-2006 and 2006-2007 school years in six schools. One of the 6th grade classes won the state competition in Community Problem Solving each year and went on to win the international competition twice.
12. Continuing outreach with 5th and 6th grades on energy and air quality through the 2008-2009 school year through funding from NSF and DOL. Prepared detailed lesson plans for teachers to continue using the modules that have been developed.
13. Planned and coordinated major community events: "Choose Clean Air" tutorial art exhibit, "Kids for Clean Air" tutorial art exhibit, and "Library Square Festival of Science and Art".