

CURRICULUM VITAE

Cecilia D. Richards (nee Cameron)
Professor
School of Mechanical and Materials Engineering
Washington State University
Pullman, WA 99164-2920

EDUCATION: Ph. D., Mechanical Engineering, 1990
University of California
Irvine, CA

M.A.Sc., Mechanical Engineering, 1985
B.A.Sc., Mechanical Engineering, 1981
B.S., Mathematics, 1977
University of British Columbia,
Vancouver, Canada

HONORS: National Science Foundation Young Investigator, 1994 - 1999

National Research Council Postdoctoral Fellowship, 1990

University of California Dissertation Fellowship, 1989/90

G.P.O.P. Fellowship, University of California, 1986 - 1989

AWARDS:

ASME Best Paper Award MEMS Division, 2005

Research Excellence in Mechanical & Materials Engineering, WSU 2003

Marshall Best Paper Award for the most significant contribution to the 9th Annual Conference of ILASS, May 1996, San Francisco, CA.

AIAA/Gordon C. Oates Air Breathing Propulsion (Graduate) Award, 1989

PROFESSIONAL EXPERIENCE:

8/05 – present *Professor*
8/98 – 7/05, *Associate Professor*,
8/92 – 8/98, *Assistant Professor*, Dept. Mechanical and Materials.
Engineering, Washington State University, Pullman, WA

10/90 - 8/92 *N.R.C. Postdoctoral Associate*,

Center for Fire Research, National Institute of Standards and Technology,
Gaithersburg, MD

6/85 - 8/86, **Research Engineer**, ITT Barton Instruments,
City of Industry, CA.

6/81 - 9/83, **Engineer**, H.A. Simons (International) Ltd.,
Vancouver, B.C.

**PROFESSIONAL
MEMBERSHIPS:**

ASME, AIAA, SAE, ILASS, Combustion Institute

SERVICE:

Professional

Program Review Committee, 25th Symposium (International) on Combustion
Program Review Committee, 26th Symposium (International) on Combustion
Program Review Committee, 27th Symposium (International) on Combustion
Program Review Committee, 28th Symposium (International) on Combustion
Program Review Committee, 29th Symposium (International) on Combustion
Program Review Committee, 30th Symposium (International) on Combustion
Program Review Committee, 31th Symposium (International) on Combustion
Reviewer, ASME National Heat Transfer Conference, 1993
Reviewer, ASME Winter Annual Meeting, 1996
Reviewer, International Mechanical Engineering Congress & Exposition, 1998
Reviewer, ASME IGTI, 1992.
Reviewer, National Science Foundation 1995 - 2006
Panelist, National Science Foundation, 1995, 1998, 2003, 2004, 2005, 2006
Reviewer, US CRDF
Reviewer, AIAA Progress Series
Reviewer, ASME Journal of Fluids Engineering
Reviewer, Petroleum Research Fund
Reviewer, AIAA Propellants & Combustion Tech. Committee.
Reviewer, Journal of Fluid Mechanics
Reviewer, Physics of Fluids
Reviewer, Journal of Laser Applications
Reviewer, Atomization & Sprays
Reviewer, Experiments in Fluids
Reviewer Applied Physics Letters
Reviewer Journal of Micromechanics and Microengineering

University

Member, Foundation Faculty Advisory Council 2003 – present
Member Dean Search Committee 2004 -2005
Chair Faculty Search Committee 2005/06
Member, Dean Review Committee, 2003
Member Strategic Planning Implementation Team, 2002 - present

Member SPFO Search Committee 2001, 2002
Chair Graduate Studies Committee 2003 – present
Member Graduate Studies Committee 2002 – 2003
Member Laboratory Equipment Committee 2003 – present
Member Safety Committee 2001-2002
Member Manufacturing Search Committee 2001
Chair Director Search Committee 1999-2000
Chair, College 120 Committee 2000
Member Internal Advisory Group 1999-2000
Member Distinguished Lecturer Series Committee (college), 1993 - 1995
Member Undergraduate Studies Committee (department) 1993 - present
Member Dean Search Committee (college), 1995
Member Faculty Search Committee (school), 1996/97
Member College Honors Committee (college) 1996 - 1997
Member Quality Focus Group (college) 1995 - 1996
Member Design Focus Group (college) 1995 - 1996
Co-ordinator, Merit Program (school) 1995 – 2000
Co-ordinator, Engr 120, 1998 – 2001
Alive Advisor 1997, 1998, 1999
Instructor/Mentor Summer Camp for Native American Students 1999
Instructor, Korean Exchange Program, 2000
SAE Faculty Advisor (college), 1993 - 1998
Robotics Club Advisor (college), 1994 - 1999
Academic Advisor for Honors Program Undergraduates 1993-present
SWE Advisor 2002 – present
Reviewer for summer doctoral fellowships, 1994

RESEARCH GRANTS:

NIH - *Implantable 16-256 Channel Data System for sleep in Mice.*, Co-Pi with Dave Rector (PI), Bob Richards, Dave Bahr, George LaRue, & Deuk Hyoun 1/06 – 1/10

NSF – *Nanotube based structures for high resolution control of thermal transport*, PI, \$1,000,000 8/04 – 7/08

Isothermal Systems Research - *Characterization of Spray Cooling Nozzles*, PI, \$25,000, 1/04 – 12/04.

TPL STTR:Navy – *Piezoelectrics for energy harvesting*, Co-PI with Dave Bahr and Bob Richards, \$30,000 6/04 -12/04

TPL SBIR:DARPA – *Integrating the P3 Microengine with TPL Inc.'s Supercapacitor Technologies*, Co-PI with Dave Bahr and Bob Richards \$190,000

M.J. Murdock Charitable Trust - *A Fabrication Facility for MEMS Devices Based on Novel Materials*, Co-PI with Dave Bahr and Bob Richards, \$401,574

Lockheed Martin Aeronautics - *The P3 Power Generation System for Converting Kinetic to Electrical Energy.*, Co-PI with Dave Bahr and Bob Richards, \$50,000, 05/16/03- 05/15/04

US ARMY SMDC - *The P³ Power Generation System for Advanced Missile Defense Applications*, Co-PI with Dave Bahr and Bob Richards, \$2,400,000 1/03 – 1/07

DARPA/MTO – *The P3 Micro Power Generator*, Co-PI with Dave Bahr and Bob Richards, \$1,400,000 10/01 – 12/05

NSF- *MEMS Based Power Generation for Portable Systems*, Co-PI with Dave Bahr and Bob Richards, NSF:XYZ on a Chip Grant, \$520,000 1999.

NSF- *Measurement & Analysis of Homogeneous Carrier-Phase Turbulence in Fluid-Particle Flows*, Co-PI with Clayton Crowe and Tim Troutt, \$104,000 1/00 – 12/00

NSF- *NSF Young Investigator*, PI, \$335,000, 8/94 – 3/01

Watkins Johnson – *Acquisition of Instructional Robots*, PI, \$58,608, 1998.

ARCO – *Acoustic Enhancement of a Coke Calciner*, PI, \$10,000, 1998

Tektronics – *Acquisition of a Color Printer*, \$9337, 1997.

Hewlett Packard- *Acquisition of an HP Workstation*, \$31,000, 1996.

Isothermal Systems Research - *Testing of Spray Quenching Nozzles*, PI, \$12,000, 10/96 - 6/97

Isothermal Systems Research - *Characterization of Spray Cooling Modules*, PI, \$4,800, 2/95 - 9/95.

Flow International Corporation- *Cleaning of Surfaces with Water Jet Technology*, \$15,000, 1995.

Hewlett Packard- *Acquisition of an HP Workstation*, \$35,000, 1995.

NSF- *Droplet Dispersion by Large Scale Structures in Axisymmetric Jets*, PI, \$90,000, 6/93 - 6/96.

NSF- *Research Experience for Undergraduates*, PI, \$39,000, 5/94 - 12/96.

NSF - *Acquisition of a Nd:YAG Laser*, PI
Research Equipment Award, \$27,500, 7/94.

Battelle PNNL- *Velocity Field in a Pseudoplastic Jet*, PI, \$18,000 1994.

WSU *Vortical Structures in Pool Fires*, PI on Grant in Aid Research Award,
\$13,000, 7/93-7/94.

**RESEARCH
SUPERVISED:**

MS

Srinath S. Chakravarty, Sean Hai Hu, Tait Swanson, Gerald Doulliard, Terry Johnson, Karuki Eichman, Chris Wark, Jeff Hall, Kevin Bruce, Nathan Stoddard, Michael Thompson, James Raupp, Owen Crabtree
Jeong Cho, Robert Gifford, Atsushi Sumiya, Brian Hollenberg, Kirsten McNeil

PhD

Hamden

Cheng Gang Xu, Roxana Bieu, Jeong Cho, Hamzeh Bardaweel, Amer

Post Doctoral

Omar Alhattemhah, Ismail Demir,
Yiming Yang, Jian Ye

**COURSES
TAUGHT:**

ME 509	MEMS Engineering
ME 561	Combustion Theory (Graduate)
ME 598	Graduate Seminar (Graduate)
ME 526	Statistical Thermodynamics (Graduate)
ME 406	Thermal Systems Laboratory (Undergraduate)
ME 402	Thermal Design
ME 436	Combustion Engines (Undergraduate)
ME 435	Thermal Systems (Undergraduate)
ME 499	Independent Study
UH 450	Honors Thesis
ME 305	Thermal Fluids Laboratory
ME 120	Intro to Engineering (Undergraduate)
ME 125	Merit (Undergraduate)

PUBLICATIONS

Keisuke Horiuchi, Prashanta Dutta, Cecilia Richards, *Experiments and simulations of mixed flows in a trapezoidal microchannel*, Microfluidics and Nanofluidics, In press

S.Dj. Mesarovic, C. M. McCarter, D.F. Bahr, H. Radhakrishnan, R.R. Richards, C.D. Richards, D. McClain, J. Jiao, *Mechanical Behavior of a carbon nanotube turf*, Scripta Materialia Vol. 56 p 157 (2007).

J.H. Cho, R. F. Richards, D.F. Bahr, C.D. Richards, *Development of noncontact spring constant measurement and deflection characterization of piezoelectric devices*, J. Applied Phys., in press.

L.W. Weiss, J. Cho, K.E. McNeil, D.F. Bahr, C.D. Richards, and R.F. Richards, *Characterization of an External Combustion Dynamic Micro Heat Engine*, Journal of Micromechanics and Microengineering, Vol. 16, p 1-8, 2006.

C. M. McCarter, S.Dj. Mesarovic, , D.F. Bahr, R.F. Richards, C.D. Richards, D. McClain, J. Jiao, *Mechanical compliance of photolithographically defined vertically aligned carbon nanotube turf*, J. Mater. Sci, In press

J.H. Cho, M.J. Anderson, R. F. Richards, D.F. Bahr, C.D. Richards, *Efficiency of energy conversion by piezoelectrics*, Applied Phys Letters, Vol 89, p 104, 2006

M.C. Robinson, D.J.Morris, P.D. Hayenga, J.H. Cho, C.D. Richards, R.F. Richards, and D.F. Bahr, "*Structural and Electrical Characterization of PZT on Gold for Micromachined Piezoelectric Membranes*, Applied Physics A, Vol. 85, p 135, 2006.

J. Cho, T. Wiser, C. Richards, D. Bahr and R. Richards, *Fabrication and Characterization of a Thermal Switch*, Sensors and Actuators, Vol 133, p 55 - 63, 2007.

S.A. Whalen, C. Richards, D. F. Bahr, and R. Richards, *Characterization of a Liquid-Vapor Phase-Change Actuator with Microcapillary Wick*, Sensors and Actuators: A. Physical, 134 (2007) 201-212

O. Al-Hattamleh, J. Cho, R. Richards, D. Bahr, C. Richards, *The effect of design and process parameters on electromechanical coupling for a thin-film PZT membrane*, JMEMS, 15,(6), p 1715, 2006

B. A. Hollenberg, C. D. Richards, R.F. Richards, D.F. Bahr, and D.M. Rector, *Fabrication of a Flexible MEMS Electrode Array for Recording Surface Field Potentials*, J. Neuroscience Methods (2006)

O. I. Crabtree, S. Dj. Mesarovic, R. F. Richards, D. F. Bahr, C. D. Richards, *Nonlinear Vibrations of a Pre-Stressed Laminated Thin late*, International J of Mech. Sciences, Vol 48, No. 4, 451 – 459 (2006).

- J. Cho, M. Anderson, R. Richards, D. Bahr, C. Richards, *Optimization of Electromechanical Coupling for a Thin Film PZT Membrane. Part I: Modeling*, Journal of Micromechanics and Microengineering, Vol. 15 pp.1797-1803, (2005)
- J. Cho, M. Anderson, R. Richards, D. Bahr, C. Richards, *Optimization of Electromechanical Coupling for a Thin Film PZT Membrane. Part II: Experiment*, Journal of Micromechanics and Microengineering, Vol. 15 pp. 1804-1809, (2005)
- C. D. Richards, M. A. Anderson, D. F. Bahr, and R. F. Richards, *Efficiency of energy conversion for devices containing a piezoelectric component*, Journal of Micromechanics and Microengineering, Vol. 14, no. 5, 717 – 721 (2004).
- I. Demir, A.L. Olson, J. L. Skinner, C. D. Richards, R. F. Richards, D. F. Bahr, *High Strain Behavior of composite thin film piezoelectric membranes*, J. Microelectronics Engineering, Vol. 75,12 – 23, (2004) .
- L.M.R. Eakins, B.W. Olson, C.D. Richards, R.F. Richards, and D.F. Bahr, *Influence of structure and chemistry on piezoelectric properties of PZT in a MEMS power generation application*, J. Mater. Res., vol. 18, pp. 2079-2086(2003).
- L.M.R. Eakins, B.W. Olson, C.D Richards, R.F Richards, D.F. Bahr, *Microstructural Characterization And Mechanical Reliability Of Pt/Pzt Interfaces In MEMS Applications*, Thin Solid Films, vol. 441, pp. 180-186 (2003).
- S. Whalen, M. Thompson, D. Bahr, C. Richards and R. Richards, *Design, Fabrication and Testing of the P3 Micro Heat Engine*, Sensors and Actuators, vol. 104, no.3, pp. 200-208, (2003).
- J. D. Hall, N. E. Apperson, B. T. Crozier, C. Xu, R. F. Richards, D. F. Bahr, and C. D. Richards, “A facility for characterizing the dynamic mechanical behavior of thin film membranes for microelectromechanical systems devices”, Review of Scientific Instruments, Vol. 73, pp. 2067-2072, 2002.
- D.F. Bahr, B.T. Crozier, C.D. Richards, and R.F. Richards, “Fatigue and Fracture in Membranes for MEMS Power Generation”, Mechanical Properties of Structural Films, STP No. 1413, C.L. Muhlstein and S.B. Brown, Eds., American Society for Testing and Materials, West Conshohocken, PA, (2001).
- Wark, C., Eickmann, K., and Richards, C., “*The Structure of an Acoustically Forced Reacting Two Phase Jet*,” Combustion and Flame, Vol. 120, No. 4, pp 93-102, 2000.
- Richards, C.D. and Richards, R.F., “*Transient Temperature Measurements in a Convectively Cooled Droplet*,” Experiments in Fluids, Vol. 25, p. 392 (1998).
- Richards, C.D., and Richards, R.F., “*Convective cooling of a suspended water droplet*,” ASME J. Heat Trans., Vol. 119, no. 2 (1997).
- Swanson, T.R. and Richards, C.D., “*The Structure of a Droplet-Laden Acoustically-Forced Jet*,” Atomization and Sprays, Vol. 7, pp. 561 - 579, 1997.

Ye, J. and Richards, C.D., "Droplet and Vapor Transport in a Turbulent Jet," 26th Symposium (International) on Combustion, pp. 1679 -1686, 1996.

Richards, C. D., Bruel, B.D., Clark, R.P., and Troutt, T.R., "Concentration Measurements in a Self-Excited Jet," Experiments in Fluids, Vol. 21, pp 103 - 109, 1996.

Shekarriz, A., Douillard, G.D., Weir, T., and Richards, C.D., "Velocity Measurements in a Turbulent Non-Newtonian Jet," ASME Journal of Fluids Engineering, Vol. 118, pp. 872, 1996.

Richards, C. D. and Pitts, W. M., "Global Density Effects on the Self-Preservation Behavior of Turbulent Free Jets," J. Fluid Mechanics, 254, Sept. 1993.

Bryner, N., Richards, C. D., and Pitts, W. M., "A Rayleigh Light Scattering Facility for the Investigation of Free Jets and Plumes," Rev. Sci. Instrum., Vol 63, No. 7, July, 1992.

Richards, C. D. and Samuelsen, G. S., "The Role of Primary Jets in the Dome Region Aerodynamics of a Model Can Combustor," ASME Journal of Engineering for Gas Turbines and Power, Vol. 114, No. 1, Jan. 1992.

Richards, C. D. and Samuelsen, G. S., "The Role of Primary Jet Injection on Mixing in a Gas Turbine Combustor," the Proceedings of the 23rd Symposium (International) on Combustion, The Combustion Institute, 1990.

McDonell, V. G., Cameron, C. D., and Samuelsen, G. S., "Symmetry Assessment of Air-Blast Atomizers," AIAA Journal of Propulsion and Power, Vol. 6, No. 4, July-August 1990.

Cameron, C. D., Brouwer, J., and Samuelsen, G. S., "A Model Gas Turbine Combustor with Wall Jets and Optical Access for Turbulent Mixing, Fuel Effects, and Spray Studies," the Proceedings of the 22nd Symposium (International) on Combustion, The Combustion Institute, 1988.

Cameron, C. D., Brouwer, J., Wood, C. P., and Samuelsen, G. S., "A Detailed Characterization of the Velocity and Thermal Fields in a Model Can Combustor with Wall Jet Injection," ASME Journal of Engineering for Gas Turbines and Power, Vol. 111, pp. 31, 1989.

Reports

Pitts, W.M., Richards, C.D., and Levenson, M. S., "Large and Small-Scale Structures and Their Interactions in an Axisymmetric Jet," NISTIR 6393, Gaithersburg, MD, October 1999.

Books

Richards, Cill, "Introduction to Engineering," McGraw-Hill , Primus Custom Publishing, 1999.

CONFERENCE PROCEEDINGS

Refereed

J. Cho, C. Richards, J. Jiao, D. Bahr, R. Richards, *Design and characterization of a MEMS thermal switch*, Hilton Head 2006, Solid State Sensor, Actuator and Microsystem Workshop, June 2-6, 2006.

Taejin Kim, Mohamed Osman, Cecilia Richards, Robert Richards and David Bahr, "*The Heat Pulse Propagations in Multiwall Carbon Nanotubes.*" 8th Annual American Physical Society Northwest Section, Tacoma, Washington. May 19-20 2006

Mohamed Osman, Taejin Kim, Cecilia Richards, Robert Richards and David Bahr, "*Radial Heat Transfer Dynamics in Multiwall Carbon Nanotubes*" 8th Annual American Physical Society Northwest Section, Tacoma, Washington. May 19-20 2006

H-K Lee, T.A. Quy, C.D.Richards, D.F. Bahr, R.F. Richards, *Experimental and Numerical Study of Evaporative Heat Transfer from Ten-Micron Microchannels*, ASME IMECE, Paper No. IMECE-15587, Chicago, IL, Nov. 5-10, 2006

J.H. Cho, C.D.Richards, D.F. Bahr, R.F. Richards, *Dynamic Operation of a MEMS Thermal Switch*, ASME IMECE, Paper No. IMECE-15286, Chicago, IL, Nov. 5-10, 2006

L.W. Weiss, J.H. Cho, D.J. Morris, D.F. Bahr, C.D.Richards, R.F. Richards, *A MEMS-Based Micro Heat Engine with Integrated Thermal Switch*, ASME IMECE, Paper No. IMECE-15042, Chicago, IL, Nov. 5-10, 2006

J.H. Cho, L.W. Weiss, C.D. Richards, D.F. Bahr, and R.F. Richards *Power Production by a Dynamic Micro Heat Engine with Integrated Thermal Switch*, PowerMEMS 06, Technical Digest, pp. , Berkeley, CA, Dec. , 2006

Taejin Kim, Mohamed Osman, Cecilia Richards, Robert Richards and David Bahr, "*Molecular Dynamics of Heat Pulse Propagation in Multiwall Carbon nanotubes.*" 7th World Congress on Computational Mechanics (WCCM), Los Angles, Califonia, July 16-22 2006

D.McClain, M. DeRoss, N. Tavan, J. Jiao, C. McCarter, R.Richards, S. Mesarovic, C. Richards, D. Bahr, *Effect of Diameter on Electron Field Emissions of Carbon Nanotube Bundles*, Mater. Res. Soc. Symp. Proc., vol. 901E. 2006

Taejin Kim, Mohamed Osman, Cecilia Richards, Robert Richards and David Bahr, "*Molecular Dynamics Simulations of Heat Pulse Propagations in Single and Multi Wall Nanotube*" 7th Annual American Physical Society Northwest Section, Victoria, British Columbia, May 13-14 2005.

L.W. Weiss, K.E. McNeil, D,F. Bahr, C.D. Richards, and R.F. Richards, *Characterization of an External Combustion Dynamic Micro Heat Engine*, Power MEMS 2005, Tokyo, Japan, Nov, 2005

J. Cho,M. Anderson, R. Richards, D. Bahr, C. Richards, *A Comparison of Piezoelectric and Elecrostatic Electromechnaical Coupling for Ultrasonic Transduction and Power Generation*, 2005 IEEE Ultrasonics Symposium, September 2005, Rotterdam, The Netherlands.

T.A. Quy, D. Carpenter, C. Richards, D. Bahr, R. Richards, *Evaporative Heat Transfer from 10 Micron Channels*, Proceedings of ASME IMECE, Paper No. IMECE2005-81460, Orlando, Nov. (2005).

S. Whalen, S. Y. Wan, C. Richards, D. Bahr, and R. Richards, *Characterization of a Model Liquid-Vapor Phase-Change Membrane Actuator*, Proceedings of ASME IMECE, Paper No. IMECE2005-82564, Orlando, Nov. (2005). Best Paper MEMS Division.

D. McClain, L.F. Dong, C.C. Pan, J. Jiao, C. McCarter, D. Bahr, C. Richards, R. Richards, "Synthesis and Microanalysis of Aligned Carbon Nanotube Arrays," Proceedings of Microscopy and Microanalysis 2005, Vol. 11, Supplement 2, 1920-1921 (2005).

S.A Whalen, S.Y. Won, R. F. Richards, D. F. Bahr, and C.D. Richards, *Characterization and Modeling of a Liquid-Vapor Phase-Change Membrane Actuator with an Integrated SU-8 Micro Capillary Wicking Structure*, Transducers '05, Paper No. AM837, Seoul, Korea, June 5-9, 2005

D. McClain, L.F. Dong, C.C. Pan, J. Jiao, C. McCarter, D. Bahr, C. Richards, R. Richards, "Fabrication of Patterned Carbon Nanotube Arrays and Study of Their Electron Field Emission," Proceedings of the 2005 Materials Research Society Fall Meeting.

C. M. McCarter, D.F. Bahr, R.F. Richards, C.D. Richards, D. McClain, and J. Jiao, "Integration of Carbon Nanotubes with MEMS through Standard Photolithographic Techniques, Proceedings of Materials Science and Technology 2005 Conference, Symposium on Nanomaterials, pp. 45-52 (2005).

M.C. Robinson, P.D. Hayenga, J.H. Cho, C.D. Richards, R.F. Richards, and D.F. Bahr, *Fabrication Methods For Improved Electromechanical Behavior In Piezoelectric Membranes*, Proceedings of the Materials Research Society, **872**, pp. J18.26 (2005)

E.K. Herzog, D.F. Bahr, C.D. Richards, R.F. Richards, and D.M. Rector, *Spatially Dependent Mechanical Properties of Rat Whiskers for Tactile Sensing*, Proceedings of the Materials Research Society. **841**, pp. R3.6/Y3.6 (2005).

J.H. Cho, J.C. Raupp, P. Hayenga, R.F. Richards, D.F. Bahr, M.J. Anderson, C.D. Richards, "Efficiency characterization of piezoelectrics for power," Proceedings of ASME IMECE, Paper No. IMECE2004-61739, Anaheim, Nov. (2004).

O. Crabtree, S. Mesarovic, I. Demir, R. Richards, D. Bahr, C. Richards, "Numerical Modeling of a Geometrically Nonlinear PZT MEMS Membrane," Proceedings of ASME IMECE, Paper No. IMECE2004-61760, Anaheim, Nov. (2004).

D.F. Bahr, M.S. Kennedy, M.C. Robinson, K.E. Shafer, C.D. Richards, R.F. Richards *Fracture and Residual Stress in Piezoelectric Thin Films for MEMS*, Advanced Materials for Energy Conversion II, TMS, Warrendale PA, pp. 393-400 (2004)

D.F. Bahr, C.D. Richards, R.F. Richards, J.V. Martinez, and T.M. Sullivan, *Piezoelectric Thin Films for Energy Conversion in MEMS*, TMS Annual Meeting, February (2004)

J.H. Cho, M.J. Anderson, R.F. Richards, D.F. Bahr, and C.D. Richards, "Analysis of micromachined PZT membranes for MEMS power, Nanotech 2004, Boston, March 2004.

M.S. Kennedy, M. Zosel, C.D. Richards, R.F. Richards, D.F. Bahr, and K.W. Hipps, *Optimization of Film Stresses in Composite Piezoelectric Membrane Microgenerators*, Proceedings of the Materials Research Society, Thin Films: Stresses and Mechanical Properties X, vol. 795, pp. 503-508 (2004).

W. Song, B. Q. Li, C. Xu and C. Richards, "A two-phase flow model for particle-gas flows and comparison with experimental measurements," Multiphase phenomena and CFD modeling and simulation in materials processing (Ed. L. Nastec and B. Q. Li), TMS, 2004, pp. 23-30.

R.M. Beiu, C.D. Richards, R.F. Richards, M.D. Fuller, D.F. Bahr, D.M. Rector, *A Flexible 64 Channel Electrode Array for Chronic Local Field Potential Recording and Mapping*, Neurosciences Meeting, New Orleans, November, 2003.

N. Stoddard, C. Richards, C. Crowe, and T. Troutt, *Turbulence modulation in an initially quiescent two-phase flow at high volume fraction using stereoscopic PIV*, ASME FEDSM2003-45212.

A.O. Christensen, J.P. Jacob, C.D. Richards, D.F. Bahr and R.F. Richards, *Fabrication and Characterization of a Liquid-Metal Micro-Droplet Array for Use as a Thermal Switch*, Proceedings of HT2003, Paper No. HT2003-40317, Las Vegas, July, 2003

A.O. Christensen, J.P. Jacob, C.D. Richards, D.F. Bahr and R.F. Richards, *Fabrication and Characterization of a Liquid-Metal Micro-Droplet Thermal Switch*, Proceedings of Transducers'03, Paper No. AM069, Boston, June, 2003.

S. Whalen, R. Richards, D. Bahr, C. Richards, "Operation and testing of a micro heat engine," NanoTech 2003, San Francisco, CA, Feb. 2003.

M. Thompson, S. Whalen, C. Richards, D. Bahr, R. Richards, *Low-Frequency Operation of the P³ Micro Heat Engine*, ASME IMECE 2002, MEMS Symposium, New Orleans, LA, Nov. 2002.

J. Skinner, A. Olson, R. Richards, D. Bahr, & C. Richards, *A Piezoelectric Membrane Generator for MEMS Power*, AIAA Nanotech 2002, Houston, Texas, Sept. 2002.

M. Thompson, S. Whalen, C. Richards, D. Bahr, R. Richards, *Design, Fabrication, and Testing of A Micro Heat Engine*, AIAA Nanotech 2002, Houston, Texas, Sept. 2002.

Skinner, J., Thompson, M., Whalen, S., Richards, R., Bahr, D. & Richards, C., *Design, Fabrication, and Testing of the P³ Micro Heat Engine*, Hilton Head 2002, Solid State Sensor, Actuator and Microsystem Workshop, June 2-6, 2002

D.F. Bahr, K.R. Bruce, B.W. Olson, L.M. Eakins, C.D. Richards, and R.F. Richards, *Electro-Mechanical Coupling And Power Generation In A PZT Micro-Engine* Proceedings of the Materials Research Society, Materials Science of Microelectromechanical Systems (MEMS) Devices IV, vol. 687, pp. 4.3.1-6 (2002)

B.W. Olson, J.L. Skinner, C.D. Richards, R.F. Richards, and D.F. Bahr, "Optimization of Thermal Processing and Chemistry in the Fabrication of a PZT Based MEMS Power Generator", Proceedings of the Materials Research Society, Perovskite Materials, vol. 718, pp. D10.25.1-7 (2002)

A.L. Olson, L.M. Eakins, B.W. Olson, D.F. Bahr, C.D. Richards, R.F. Richards, *PZT And Electrode Enhancements Of Mems Based Micro Heat Engine For Power Generation*, Proceedings of the Materials Research Society, Materials for Energy Storage, Generation, and Transport, vol. 730, pp. V5.19.1-.6 (2002)

K. Bruce, R. Richards, D. Bahr, & C. Richards, *Characterization of a Piezoelectric Membrane for MEMS Power*, Proceedings ASME IMECE 2001– vol. 2, MEMS Symposium, Paper No. MEMS-23803, New York, New York, November 2001.

C.D. Richards, D.F. Bahr, C-G Xu and R.F. Richards, *The P³ Micro Power Generation System*, Proceedings ASME IMECE 2001 – vol. 1, Microscale Thermal Phenomena in Energy Systems, Paper No. HTD-24283, New York, New York, November 2001.

D.F. Bahr, B.T. Crozier, C.D. Richards, and R.F. Richards, *Defects and Failure Modes in PZT Films for a MEMS Microengine*, in Proceedings of the Materials Research Society, Materials Science of MEMS Devices III, vol. 657, pp. EE4.4.1-.6 (2001)

C.D. Richards, D.F. Bahr, C-G Xu & R.F. Richards, *MEMS Power: The P³ System*, Proceedings of IECEC 2001, 36th Intersociety Energy Conversion Engineering Conference, Savannah, Georgia, July - August, 2001.

B.W. Olson, L.M. Randall, C.D. Richards, R.F. Richards, and D.F. Bahr, *Relationships Between Microstructure and Reliability in PZT MEMS*, in Proceedings of the Materials Research Society, Transport and Microstructural Phenomena in Oxide Electronics, vol. 666, pp. F6.1.1-.9 (2001).

Wark, C. & Richards, C., *Fuel Effects on the Structure of a Forced Spray Flame*, ICLASS 2000, Pasadena CA.

C. Xu, J. Hall, C. Richards, D. Bahr, R. Richards, *Design of a Micro Heat Engine*, ASME IMECE, Nov., 2000

D.F. Bahr, B.T. Crozier, C.D. Richard, R.F. Richards, *Fatigue and Fracture in Membranes for MEMS Power Generation*, ASTM Committee E8 on Fatigue and Fracture, Symposium on Mechanical Properties of Structural Films, (2000)

Pitts, W.M., Richards, C.D., and Levenson, M.S., "Interactions between Large- and Small-Scale Turbulent Structures in the Scalar Mixing Field of an Axisymmetric Turbulent Jet." 20th International Congress of Theoretical and Applied Mechanics, Chicago, IL, August 2000.

Xu, C.C. and Richards, C. D., "Two-Way Coupling in a Droplet-Laden Jet," presented at the 1999 ASME Fluids Engineering Division Summer Meeting, San Francisco, July, 1999.

Johnson, T.A. and Richards, C.D., “*Droplet Dispersion in a Round Jet: The Role of Secondary Structures*,” 1997 ASME Fluids Engineering Division Summer Meeting, FEDSM97-3620.

Richards, C. and Shekarriz, A., “*Characteristics of a Submerged Non-Newtonian Jet*,” 1997 ASME Fluids Engineering Division Summer Meeting, FEDSM97- 3076..

Xu, C., Richards, C., Crowe, C., and Troutt, T., “*The Simulation of Vapor Transport in an Acoustically-Forced Jet*,” 1997 ASME Fluids Engineering Division Summer Meeting, FEDSM97-3619.

Richards, C.D. and Richards, R.F., “*Transient Temperature Measurements in a Suspended Droplet*,” for presentation and publication in the proceedings of the 32nd National Heat Transfer Conference, ASME, August 1997, Baltimore, MD.

Shekarriz, A., Douillard, G.D., Weir, T., and Richards, C.D., “*Rheology and Reynolds Number Effects on the Velocity Field of a Yield-Pseudoplastic Jet*,” ASME FED-Vol. 207, 1995, pp. 1 - 7.

Swanson, T.R., Ye, J., and Richards, C.D., “*Particle Transport and Dispersion in the Near Field of a Turbulent Jet*,” ASME FED-Vol. 222, 1995.

Petersen, D., Hu, S.H., Richards, C.D., and Richards, R.F., “*The Measurement of Droplet Temperature Using Thermochromic Liquid Crystals*,” ASME HTD-Vol. 308, 1995, pp 39 - 46.

Nonrefereed Conferences

Richards, R.F., Richards, C.D., Bahr, D.F., *Progress on the development of a micro heat engine*, 2002 NSF Design, Service and Manufacturing Grantees and Research Conference, Huntsville, AL, Dec. 2002.

R. Richards, D. Bahr, & C. Richards, *The P3 Micro Power Generator*, Proceedings DARPA/MTO MEMS/MPG/NMASP Principal Investigators’ Meeting, Bloomington, CO, August, 2001.

Richards, R.F., Richards, C.D., Bahr, D.F., *Design for Micromanufacture: A Micro Heat Engine*, 2001 NSF Design, Service and Manufacturing Grantees and Research Conference, Tampa, Florida, Jan 2001.

Bahr, D., Fiez, T., Li, B., Mayaram, K., Richards, C., & Richards, R., *Mems-Based Power Generation for Portable Systems*, NSF “XYZ on a Chip” grantees meeting, Arlington, VA, May 2000.

D.F. Bahr, B.T. Crozier, C.D. Richards, and R.F. Richards, *Defects and Failure Modes in PZT Films for a MEMS Microengine*, Materials Research Society Fall Meeting, Symposium EE, Materials Science of MEMS Devices III (2000)

J. Hall, N. Apperson, D.Bahr, A. Bandyopadhyay, C. Richards, and R. Richards, *Piezoelectric Thin Films for Micro-Power Generation*, ASME IMECE , Orlando, Florida, Nov., 2000

Wark, Chris and Richards, Cill, “*Fuel Effects on the Structure of a Forced Spray Flame*,” ICLASS, Pasadena, July 2000.

Pitts, W. M. and Richards, C. D., 1999 Division of Fluids Dynamics Meeting, American Physical Society, New Orleans, LA, November 21-23, 1999.

Wark, Chris and Richards, Cill, "*An Experimental Study of an Acoustically-Forced Spray Flame,*" ILASS Americas, Indianapolis, May, 1999.

Wright, R., Fincke, J., Swank, W., Haggard, D., Richards, C. and Richards, R., "*Characterization of metal sprays produced by the twin-wire arc process,*" ILASS Americas, Sacramento, May 1998.

Xu, C., Richards, C., Crowe, C., and Troutt, T., "*A Two-Way Coupling Discrete Vortex Method for Two-Phase Jet Flow,*" ILASS Americas, Sacramento, May 1998.

Eickmann, K. and Richards, C., "*The Structure of a Reacting Droplet-Laden Forced Jet,*" presented at the 1997 ILASS Conference, May 1997, Ottawa, Canada.

Johnson, T. and Richards, C., "*Droplet Dispersion through Vortex Pairing in the Near Field of a Turbulent Jet,*" presented at the 1997 ILASS Conference, May 1997, Ottawa, Canada.

Petersen, D, Richards, C.D., and Richards, R.F., "*The Visualization of Temperature and Flow Within a Drop,*" presented at the Twenty Sixth Symposium (International) on Combustion, August 1996, Naples, Italy.

Swanson, T.R. and Richards, C.D., "*Droplet-Vortex Interaction in a Turbulent Jet,*" presented at the 9th Annual Conference of ILASS, May 1996, San Francisco, CA.

Ye, J. and Richards, C.D., "*Droplet and Vapor Transport in a Turbulent Jet,*" presented at the 9th Annual Conference of ILASS, May 1996, San Francisco, CA.

Petersen, D, Richards, C.D., and Richards, R.F., "*The Visualization of Temperature and Flow Within a Drop,*" presented at the 9th Annual Conference of ILASS, May 1996, San Francisco, CA.

Chakravarty, S.S., Yang, Y., and Richards, C.D., "*An Experimental Study of Droplet-Vortex Interactions in a Turbulent Round Jet,*" AIAA 94-3280, presented at the 30th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, June 27 - 29, 1994.

Hu, S.H., Richards, R.F., and Richards, C.D., "*Thermography of atomized droplets in flight using thermographic liquid crystals,*" presented at ILASS, May 31 - June 3, 1994, Bellevue, WA.

Yang, Y. and Richards, C.D., "*Droplet-Vortex Interactions in a Turbulent Round Jet,*" presented at the Spring meeting of the Western States Section of the Combustion Institute. March 20 - 23, 1993, Davis CA.

Richards, C. D. and Pitts, W. M., "*An Experimental Study of the Stabilization Region of a Lifted Diffusion Flame,*" presented at the 1991 Fall Technical Meeting of the Eastern States Section of the Combustion Institute, Oct., 1991, Ithaca, New York.

Richards, C. D. and Samuelsen, G. S., "*The Aerodynamic Field of Opposed Radial Jets in a Swirling Cylindrical Duct Flow,*" presented at the 1990 Fall Technical meeting of the Eastern States Section of the Combustion Institute, Dec., 1990, Orlando, Florida.

Richards, C. D. and Samuelsen, G. S., "*The Interaction of Primary Jets with a Swirl-Induced Recirculation Zone*," AIAA-90-0455 presented at the AIAA 28th Aerospace Sciences Meeting, Reno, Jan. 1990.

Cameron, C. D., Brouwer, J., and Samuelsen, G. S., "*A Comparison of Spray Characterization in an Isothermal Chamber and in a Model Gas Turbine Can Combustor*," presented at the 4th International Conference on Liquid Atomization and Spraying Systems (ICLASS), Tokyo, Japan, Aug. 22 - 24, 1988.

Brouwer, J., Cameron, C. D., and Samuelsen, G. S., "*A Parametric Investigation of a Model Gas Turbine Combustor*," presented at the 24th AIAA/SAE/ASME/ASEE Joint Propulsion Conference, Boston, Massachusetts, July 11 - 13, 1988.

Cameron, C. D., McDonell, V. G., and Samuelsen, G. S., "*Symmetry Assessment of a Gas Turbine Air-Blast Atomizer*," presented at the AIAA/SAE/ASME/ASEE 23rd Joint Propulsion Conference, San Diego, CA, June 1987.

Evans, R. L. and Cameron, C. D., "*A New Combustion Chamber for Fast Burn Applications*," presented at the International Congress and Exhibition, Detroit, MI, SAE860319, 1986.

INVITED PRESENTATIONS

"A thermal switch for cooling of electronics," SRC Review, Amherst MA, October , 2006.

"High resolution control of thermal transport," SRC, August 2005.

"The P3 Micropower system," Army Research Laboratory, October 2002.

"Design, Fabrication, and testing of a micro heat engine for MEMS power," Sandia National Labs, Livermore, CA August 2002.

"A MEMS Based Power Supply" Army Research Laboratory September 2000.

"The P3 Micro Engine" Army Research Laboratory October 2000.

"Flow Visualization in Two-Phase Jets," Summer meeting of the Fluids Division of the ASME, San Francisco, CA, 1999.

"Two-Phase Flows," with Crowe, C.T. and Troutt, T.R., ILASS Americas, Indianapolis, May, 1999.

"Transport processes in two-phase jets," National Institute of Standards and Technology, February 1998.

"Mixing in Two-Phase Turbulent Jets," Department of Mechanical Engineering, University of Washington, March, 1995.

"Droplet Vortex Interactions in a Turbulent Round Jet," NSF/DOE Joint Workshop on Particulate/Multiphase Flow, October 5 - 7, 1994.

“Dispersion and Transport in Droplet- Laden Jets,” Allison Gas Turbines, Indianapolis, July, 1994.

“Global Density Effects on the Self-Preservation Behavior of Turbulent Free Jets,” Department of Mechanical Engineering, University of British Columbia, March, 1993.

“Turbulent Mixing in Variable Density Jets,” Applied Physics, Battelle PNL, June 1993.