

Cullen R. Buie, Ph.D.

Assistant Professor

Mitsui Career Development Chair
Department of Mechanical Engineering
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**Massachusetts
Institute of
Technology**

EDUCATION

Stanford University

2009 **Doctor of Philosophy, Mechanical Engineering**
Dissertation: "Application of Electroosmotic Pumps to Low Temperature Fuel Cells"
Ph.D. Advisor: Juan G. Santiago

2005 **Master of Science, Mechanical Engineering**

The Ohio State University

2003 **Bachelor of Science, Mechanical Engineering, *magna cum laude***
Undergraduate Honors Thesis: "Modeling, Analysis, and Application of NiTi Shape Memory Alloy Wire"

RESEARCH APPOINTMENTS

2010 – present **Massachusetts Institute of Technology, Cambridge, MA**
Department of Mechanical Engineering
Mitsui Career Development Chair

2009 – present **Massachusetts Institute of Technology, Cambridge, MA**
Department of Mechanical Engineering
Assistant Professor

2008 – 2009 **University of California-Berkeley, Berkeley CA**
Professor Liwei Lin, PI
University of California President's Postdoctoral Fellow

2003 – 2008 **Stanford Microfluidics Laboratory, Stanford, CA**
Professor Juan Santiago, PI
Graduate Research Assistant

Summer 2006 **Lawrence Livermore National Laboratory, Livermore, CA**
Summer Research Scholar

2001 – 2003 **Intelligent Structures and Systems Laboratory, Columbus, OH**
Professor Gregory Washington, PI
Undergraduate Research Assistant

JOURNAL PUBLICATIONS

Braff, W.A., Pignier, A., and Buie, C.R., "High sensitivity three-dimensional insulator-based dielectrophoresis," *Lab on a Chip*, 2011 (accepted).

Inoue, S., Parra, E.A., Higa, A., Jiang, Y., Wang, P., Buie, C.R., Coates, J.D., Lin, L., "Structural optimization of contact electrodes in microbial fuel cells for current density enhancements," *Sensors and Actuators A: Physical*, 2011 (accepted).

- Joung, Y.S. and C.R. Buie, "Electrophoretic Deposition of Unstable Colloidal Suspensions for Superhydrophobic Surfaces," *Langmuir*, 2011, 27, p. 4156.
- Buie, C. R. and J.G. Santiago, "Two Phase Hydrodynamics in a Miniature Direct Methanol Fuel Cell," *International Journal of Heat and Mass Transfer*, 2009, 52, p. 5158.
- Litster, S., Buie, C. R., and J.G. Santiago, "Engineering Model for Coupling Wicks and Electroosmotic Pumps with Proton Exchange Membrane Fuel Cells for Active Water Management," *Electrochimica Acta*, 2009, 54, p. 6223.
- Buie, C. R.; Kim, D.; Litster, S.; and J.G. Santiago, "An Electroosmotic Fuel Pump for Direct Methanol Fuel Cells," *Electrochemical and Solid-State Letters*, 2007, 10, p. B196.
- Litster, S., Buie, C. R., Fabian, T., Eaton, J. K., and J.G. Santiago, "Active Water Management for PEM Fuel Cells," *Journal of the Electrochemical Society*, 2007, 154, p. B1049.
- Buie, C.R., Posner, J.D., Fabian, T., Cha, S.W., Kim, D., Prinz, F.B., Eaton, J.K., and J.G. Santiago, "Water Management in Proton Exchange Membrane Fuel Cells using Integrated Electroosmotic Pumping," *Journal of Power Sources*, 2006, 161, p.191.

REFEREED CONFERENCE PUBLICATIONS

- Joung, Y.S. and C.R. Buie, "Hybrid Electrophoretic Deposition with Anodization Process for Superhydrophilic Surfaces to Enhance Critical Heat Flux," to be published in the Proceedings of the 4th International Conference on Electrophoretic Deposition, Puerto Vallarta, MX, October 2-7, 2011.
- Palmer, T.R. and C.R. Buie, "Fundamentals of Pulsed and Direct Current Electrophoretic Infiltration Kinetics," to be published in the Proceedings of the 4th International Conference on Electrophoretic Deposition, Puerto Vallarta, MX, October 2-7, 2011.
- Braff, W.A. and C.R. Buie, "Novel Hydrogen Bromine Fuel Cell for High Power Density Applications," to be published in the Proceedings of the 2010 Fall Electrochemical Society Meeting, Las Vegas, NV, October 10-15, 2010.
- Blaesi, A. and C.R. Buie, "Characterization of Pt and Pt-Alloy Catalysts for the Oxidation of Glucose," to be published in the Proceedings of the 2010 Fall Electrochemical Society Meeting, Las Vegas, NV, October 10-15, 2010.
- Parra, E.A., Higa, A., Buie, C.R., Coates, J.D. and L. Lin, "Real-Time Biocatalyst Loading and Electron Transfer via Microfabricated Transparent Electrode," published in the Proceedings of the 23rd IEEE Conference on Micro Electro Mechanical Systems, Hong Kong, January 24-28, 2010.
- Buie, C.R., Parra, E. A., Sochol, R.D., Coates, J. D. and L. Lin, "Characterization of Bacteria for Microbial Fuel Cell Applications Using Dielectrophoresis," published in the Proceedings of The 13th International Conference on Miniaturized Systems for Chemistry and Life Sciences, Jeju, Korea, November 1-5, 2009.
- Buie, C.R., and Santiago, J.G., "Model and Experimental Study of Hydrodynamic Coupling between a Fuel Pump and a Direct Methanol Fuel Cell," published in the Proceedings of the 214th Meeting of the Electrochemical Society, Honolulu, HI, October 12 – 17, 2008.
- Buie, C.R., Litster, S., and J.G. Santiago, "Physics of Pumping Methanol/Water Solutions for Fuel Cell Applications," published in the Proceedings of the ASME International Mechanical Engineering Conference and Exposition, Seattle, WA, IMECE2007-42579, November 11-15, 2007. (Best Student Paper Award)

- Buie, C.R., Buckley, P., Hamilton, J., Ness, K.D., Rose, K.A., "Droplet-based Segregation and Extraction of Concentrated Samples," published in the Proceedings of the 10th Annual NSTI Nanotech Meeting, Santa Clara, CA, May 20-24, 2007.
- Buie, C.R., Litster, S.E., Kim, D., Santiago, J.G., "Free Convection Direct Methanol Fuel Cells Powered by Electroosmotic Pumps," published in the Proceedings of the 210th Meeting of the Electrochemical Society, Cancun, MX, October 28 – November 3, 2006.
- Kim, D, Buie, C.R., Santiago, J.G., "Towards Electroosmotic Flow-Driven Air Pumps for Miniaturized PEM Fuel Cells," published in the Proceedings of the 210th Meeting of the Electrochemical Society, Cancun, MX, October 28 – November 3, 2006.
- Buie, C.R., Banin, Y., Tang, C., Santiago, J.G., Prinz, F.B., Pruitt, B.L., "A Microfabricated Direct Methanol Fuel Cell with Integrated Electroosmotic Pump," published in the Proceedings of the 19th IEEE Conference on Micro Electro Mechanical Systems, Istanbul, Turkey, January 22-26, 2006.
- Buie, C.R., Posner, J.D., Fabian, T., Cha, S.W., Prinz, F.B., Eaton, J.K. and J.G. Santiago, "Active Water Management for Proton Exchange Membrane Fuel Cells Using an Integrated Electroosmotic Pump," published in the Proceedings of the International Mechanical Engineering Conference and Exposition, Orlando, FL, IMECE2005-79728, November 5-11, 2005. (Best Student Paper Award)
- Buie, C.R., Posner, J.D., Fabian, T., Cha, S.W., Prinz, F.B., Eaton, J.K. and J.G. Santiago, "Water Removal from Proton Exchange Membrane Fuel Cells via Electroosmotic Pumping," published in the Proceedings of the 208th Meeting of the Electrochemical Society, Los Angeles, CA, October 16-21, 2005.

CONFERENCE PRESENTATIONS

- Joung, Y.S. and C.R. Buie, "Drop Impingement on Highly Wetting Micro/Nano Porous Surfaces," presented at the APS 64th Annual Division of Fluid Dynamics Meeting, Baltimore, MD, November 20-22, 2011.
- Braff, W.A., Wilner, D., Hugenholtz, P., Rabaey, K., and C.R. Buie, "High Sensitivity Insulator Based Dielectrophoretic Phenotyping of Bacteria," presented at the American Electrophoresis Society Meeting, Minneapolis, MN, October 16-20, 2011.
- C.R. Buie, "Alternative Energy: A New Frontier for Microfluidics," presented at the American Physical Society March Meeting, Dallas, TX, March 21-25, 2011. **(Invited)**
- Braff, W.A. and C.R. Buie, "DC-Biased AC Dielectrophoresis for Electrical Characterization of Bacteria," presented at the 13th International Symposium on Microbial Ecology, Seattle, WA, August 22-27, 2010.
- Joung, Y.S. and C.R. Buie, "Electrophoretic Deposition of Unstable Colloidal Suspensions for Superhydrophobic Surfaces," presented at the 84th ACS Colloid and Surface Science Symposium, Akron, OH, June 20-23, 2010.
- Buie, C.R., Litster, S.E., and J.G. Santiago, "In Situ Visualization of Liquid Water Removal in an Operating Proton Exchange Membrane Fuel Cell," presented at the 5th International ASME Fuel Cell Science, Engineering, and Technology Conference, New York, NY, June 18-20, 2007.
- Buie, C.R., Kim, D., Litster, S.E., and J.G. Santiago, "Electroosmotic Pumps for Fuel Delivery to Direct Methanol Fuel Cells," presented at the Thermal and Fluid Sciences Affiliates Conference, Stanford, CA, February 7-9, 2007.
- Buie, C.R., Kim, D., Litster, S., and J.G. Santiago, "Electroosmotic Pumps for Fuel Delivery to Direct Methanol Fuel Cells," 2006 AIChE Annual Meeting, San Francisco, CA, November 12-17, 2006.
- Litster, S., Buie, C.R., Fabian, T., Posner, J.D., and J.G. Santiago, "Water Management in a 25 cm² PEM Fuel Cell with Electroosmotic Pump," 2006 AIChE Annual Meeting, San Francisco, CA, November 12-17, 2006.

Cha, S. W.; Fabian, T.; Posner, J.; Prinz, F. B.; Buie, C.; Eaton, J. K.; Kim, D. J.; and J.G. Santiago, "Direct water removal in gas diffusion layer of proton exchange membrane fuel cells by a flexible electroosmotic pump," Proceedings of the 4th International ASME Conference on Fuel Cell Science, Engineering and Technology, 2006.

Buie, C.R., Posner, J.D., Fabian, T., Cha, S.W., Prinz, F.B., Eaton, J.K. and J.G. Santiago, "Flooding Mitigation in Proton Exchange Membrane Fuel Cells Using Electroosmotic Pumps," 32nd Annual National Society of Black Engineers Convention, Pittsburgh, PA, March 29-April 2, 2006. (Best Paper Award)

Buie, C.R., Posner, J.D., Fabian, T., Cha, S.W., Prinz, F.B., Eaton, J.K. and J.G. Santiago, "Active Water Management for Proton Exchange Membrane Fuel Cells Using an Integrated Electroosmotic Pump," presented at the Thermal and Fluid Sciences Affiliates Conference, Stanford, CA, February 1-3, 2006.

Buie, C.R., Banin, Y., Tang, C., Santiago, J.G., Prinz, F.B., Pruitt, B.L., "A Microfabricated Direct Methanol Fuel Cell with Integrated Electroosmotic Pump," presented at the Stanford Opportunity Job Fair Technical Poster Session, Stanford, CA, January 27, 2006. (Best Poster Award Winner)

Buie, C.R., Posner, J.D., Fabian, T., Cha, S.W., Prinz, F.B., Eaton, J.K. and J.G. Santiago, "Active Water Management for Proton Exchange Membrane Fuel Cells Using an Integrated Electroosmotic Pump," presented at the Seoul National University/Stanford University Joint Meeting, Stanford, CA, June 21-22, 2005.

INTELLECTUAL PROPERTY

C.R. Buie and Y.S. Joung, Electrophoretic-Deposited Surfaces, MIT (USPTO Provisional Filed February 2011).

T. Fabian, S. Litster, J.G. Santiago, C.R. Buie, J. Sasahara, and T. Kubota, Heat and Water Management Device and Method in Fuel Cells, The Board of Trustees of the Leland Stanford Junior University and Honda Giken Kogyo Kabushiki Kaisha (USPTO application filed 2007).

T. Fabian, S. Litster, J.G. Santiago, C.R. Buie, H. Tsuru, J. Sasahara, and T. Kubota, Fuel Cell Water Management, The Board of Trustees of the Leland Stanford Junior University and Honda Giken Kogyo Kabushiki Kaisha (USPTO application filed 2007).

J. Santiago, J. Posner, F. B. Prinz, T. Fabian, J. Eaton, S.-W. Cha, C. Buie, D. Kim, H. Tsuru, J. Sasahara, T. Kubota and Y. Saito, Fuel cell with electroosmotic pump, The Board of Trustees of the Leland Stanford Junior University and Honda Giken Kogyo Kabushiki Kaisha, US 2006/0029851.

INVITED PRESENTATIONS

2011	November	The University of Texas at Austin, Department of Mechanical Engineering
2011	September	Harvard University, Prof. Gilmore Research Group Seminar
2011	September	Duke University, Department of Mechanical Engineering
2011	August	Harvard University, Prof. Wessels Research Group Seminar
2011	July	Naval Research Laboratory, Center for Bio/Molecular Science and Engineering
2011	April	The University of Queensland, Advanced Water Management Center
2010	October	Georgia Institute of Technology, Mechanical Engineering
2010	June	Lawrence Livermore National Laboratory
2008	December	University of California, Berkeley, Prof. Newman Research Group Seminar
2008	December	University of California, Berkeley, Berkeley Sensor and Actuator Center
2008	March	Princeton University, Mechanical and Aerospace Engineering
2008	March	Cornell University, Mechanical and Aerospace Engineering
2008	March	Massachusetts Institute of Technology, Mechanical Engineering
2008	February	University of Illinois, Urbana-Champaign, Mechanical Science and Engineering
2008	February	University of California, Berkeley, Berkeley Nanosciences and Nanoengineering Institute

2008	February	Carnegie Mellon University, Department of Mechanical Engineering
2008	January	University of Michigan, Department of Mechanical Engineering
2007	October	Auburn University, Department of Mechanical Engineering
2007	October	University of Michigan, Department of Mechanical Engineering
2007	October	The Ohio State University, Department of Mechanical Engineering
2007	July	Argonne National Laboratory, Fuel Cell Technology Department
2007	May	The Ohio State University, Department of Mechanical Engineering

ADVISEES

MIT

2011 - present	Soon Ju Choi, B.S. Mech & Aer. Eng., Seoul National University
2011 - present	Zhifei Ge, B.S. Mechanical Engineering, Shanghai Jiao Tong University
2010 - present	Andrew Jones III, B.S. Mechanical Engineer, MIT
2010 - present	Alisha Schor, M.S. Mechanical Engineering, MIT
2009 - present	William Braff, B.S. Physics, Yale University
2009 - present	Youngsoo Joung, M.S. Mech & Aer. Eng., Seoul National University
2009 - 2011	Timothy Palmer, M.S. Mechanical Engineering, MIT
Summer 2010	Alexei Bordas, B.S. Mechanical Engineering (expected 2011), University of Miami (MIT Summer Research Program)
2009 - 2010	Aron Blaesi, M.S. Mech. Eng., ETH - Zurich

UC Berkeley

Summer 2009	Kristina Roe, B.S. Chem. Eng., University of Michigan (2010)
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Stanford University

Summer 2008	Viktor Shkolnikov, B.S. Mech. Eng., Stanford University (2009)
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TEACHING EXPERIENCE

Massachusetts Institute of Technology, Department of Mechanical Engineering

Spring 2011	2.005 - Thermal Fluids Engineering I, Lecturer
Fall 2010	2.005 - Thermal Fluids Engineering I, Recitation Instructor
Spring 2010	2.671 - Measurement and Instrumentation, Laboratory Instructor

Stanford University, Department of Mechanical Engineering

Fall 2007	Experimental Methods in Fluid Mechanics – Laboratory Assistant
Spring 2007	Fuel Cell Science and Technology – Course Assistant
Spring 2006	Microelectromechanical Systems Laboratory – Laboratory Assistant

PROFESSIONAL EXPERIENCE

Summer 2002	The Dow Chemical Company, Midland, MI Commercial Development Intern Researched potential markets for Industrial Grade Syndiotactic Polystyrene and presented proposed solutions to the global business team.
Summer 2001	The Procter and Gamble Company, Cincinnati, OH Technical Engineering Intern Conducted four projects in the areas of quality and manufacturing which resulted in \$500k in realized savings and \$300k in potential savings for the company across several businesses.
Summer 2000	The Polaroid Corporation, Waltham, MA Equipment Engineering Intern

Performed five projects, which resulted in reductions of downtime on four different production machines and a savings of \$60k per year on one production machine.

AWARDS AND HONORS

2010	Mitsui Career Development Chair
2010	NSF Minority Faculty Development Workshop, Best Poster
2008	University of California, President's Postdoctoral Fellowship
2007	American Society of Mechanical Engineers Graduate Teaching Fellow
2007	Ford Foundation Dissertation Fellowship
2006	Link Foundation Energy Fellowship Recipient (Declined Award)
2005	Link Foundation Energy Fellowship, Honorable Mention
2003	National Science Foundation Graduate Research Fellowship
2002	Rhodes Scholarship State Finalist (Ohio)
2002	Barry M. Goldwater Scholarship
2002	Elected to The Honor Society of Phi Kappa Phi
2002	Elected to The Honor Society of Tau Beta Pi
2000	Dow Chemical Company Emerging Scholar
1999	National Achievement Scholarship Semi-Finalist
<u>Stanford University</u>	
2007	James W. Lyons Award for Student Service
2007	Stanford Black Community Services Center 2007 Graduate Student of the Year
2006	Stanford Black Community Services Center 2006 Graduate Student of the Year
<u>The Ohio State University</u>	
2003	Outstanding Senior Award
2003	Kaplan Humanitarian Award
2003	Board of Trustees Student Recognition Award
2002	Denman Undergraduate Research Forum, Top Junior Award
2002	Denman Undergraduate Research Forum, Second Place in Engineering Sciences
2002	Homecoming Court
2002	Emerging Leaders Citation
2002	Minority Engineering Program Eminent Scholar Award
2001 – 2002	African American Scholarship (Homecoming) Pageant King
2001	Denman Undergraduate Research Forum, Top Sophomore Award
2001	African American Student Services Distinguished Academic Achievement Award
1999	Office of Minority Affairs Excellence Scholarship
<u>The National Society of Black Engineers (NSBE)</u>	
2004	Stanford University, chapter member of the year
2004	NSBE Fellow Award
2002	The Ohio State University, chapter member of the year
2000 – 2002	Torchbearer Award
2000	NSBE Fellow Award
2000 – 2001	Region IV Oratorical Contest Champion

LEADERSHIP AND SERVICE EXPERIENCE

2011 - present	Associate Housemaster, MIT-Maseeh Hall
2011 - present	MIT School of Engineering Ad-Hoc Diversity Committee
2011	Mechanical Engineering Strategic Planning Committee
2010 - present	Mechanical Engineering Graduate Admissions Committee
2010 - 2011	4 th International Conference on Electrophoretic Deposition, Organizing Committee
2008	Keynote Speaker, 8 th Annual Man to Man Conference, Columbus OH
2008	Graduate Student Speaker, Stanford Black Graduation Celebration
2007 – 2008	Associated Students of Stanford University (ASSU) Executive Cabinet
2006 – 2008	Stanford Alumni Association Board of Directors (student representative)
2005 – 2007	Stanford Graduate Student Council Engineering Representative

2005 – 2007 Stanford Graduate Student Council Diversity Committee Co-Chair
2004 – 2005 Vice President of the Stanford Black Graduate Student Association
2004 Stanford Summer Engineering Academy, Resident Fellow
2003 The Ohio State University PREFACE program, Resident Fellow
2002 – 2003 President of The National Society of Black Engineers (NSBE) @ OSU
2002 – 2003 Founding Member of The Association of Black Leaders for Entrepreneurship
2002 – 2003 Member of The Academy of African American Male Leadership
2002 – 2003 Afrikan Student Union (ASU) Organizing Committee
2002 African American Heritage Festival Weekday Events Planning Committee
2001 – 2003 Office of Minority Affairs (OMA) Peer mentor
2000 – 2003 The Ohio State University Honors Ambassadors
2001 – 2002 Young David's Ministry Steering Committee, New Salem Missionary Baptist Church
2000 – 2001 Membership Chair for NSBE @ OSU
2000 – 2002 Academic Excellence Chair for Lambda Psi Engineering Honorary