

# GEORGE J. NELSON

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Huntsville, AL 35899

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(256) 824-5082

## **Education:**

**Georgia Institute of Technology, Atlanta, Georgia**

**Ph.D. in Mechanical Engineering, awarded December 2009**

*Computational Characterization of Diffusive Mass Transfer in Porous Solid Oxide Fuel Cell Components*

Major: Energy Systems, Minor: Applied Mathematical Modeling

Advisors: Dr. William Wepfer and Dr. Comas Haynes

**Master of Science in Mechanical Engineering, awarded May 2006**

*Solid Oxide Cell Constriction Resistance Effects*

Advisors: Dr. Jianmin Qu and Dr. Comas Haynes

**Bachelor of Science in Mechanical Engineering, Cum Laude, awarded May 2003**

## **Appointments:**

**Assistant Professor**

8/12 to Present

**University of Alabama in Huntsville (UAH)**

**Mechanical and Aerospace Engineering Department**

Huntsville, Alabama

**Assistant Research Professor**

10/09 to 7/12

**University of Connecticut**

**Department of Mechanical Engineering**

Storrs, Connecticut

## **Primary Research Interests:**

Transport phenomena in energy conversion and storage devices, multi-scale modeling of energy systems, microstructural characterization

## **Awards and Honors:**

- National Science Foundation Faculty Early Career Development (CAREER) Award (2015)
- UAH Distinguished Research Award (2015)
- UAH College of Engineering Outstanding Faculty Member (2015)
- UAH College of Engineering Faculty Research Award (2014-2015)
- UAH College of Engineering Outstanding Junior Faculty Member (2015)
- Oak Ridge Associated Universities Ralph E. Powe Junior Faculty Enhancement Award (2013)
- Oak Ridge National Laboratory HERE Program (2005)
- Georgia HOPE Scholar (1997 to 2003)

## **Publications:**

*Journal Papers in Preparation*

24. E. E. Looney, G. J. Nelson, Z. K. van Zandt, Y. Ulyanova, S. Singhal, L. Santodonato and H. Bilheux, "Ex Situ and In Situ Neutron Imaging of Enzymatic Electrochemical Cells", *In Preparation*, 2016.

*Submitted Journal Papers*

23. Z. K. van Zandt and G. J. Nelson, "Solid Oxide Cell Microstructural Performance for Hydrogen and Carbon Monoxide Reactant Streams", *ASME Journal of Electrochemical Energy Conversion and Storage*, 2016, *In Revision*.

*Published Journal Papers* (†Equal Contribution)

22. G. J. Nelson, "An Analytical Approach to Solid Oxide Cell Electrode Geometric Design," *Journal of Power Sources*, 2015, 300: p. 365-375.
21. M. B. DeGostin, A. Nakajo, B. N. Cassenti, A. A. Peracchio, G. J. Nelson, W. K. S. Chiu, "Geometric Sensitivity of Electrochemical Fin Shape on Three Dimensional Microstructure Network Conductivity Analysis," *Journal of Power Sources*, 2015, 291: p. 181-194.
20. G. J. Nelson, A. Nakajo, B. N. Cassenti, M. B. Degostin, K. R. Bagshaw, A. A. Peracchio, G. Xiao, S. Wang, F. Chen and W. K. S. Chiu, "A Rapid Analytical Assessment Tool for Three Dimensional Electrode Microstructural Networks with Geometric Sensitivity," *Journal of Power Sources*, 2014, 246: p. 322-334.
19. B. N. Cassenti, G. J. Nelson, M. B. DeGostin and W. K. S. Chiu, "Exact Solutions for One-Dimensional Transport in Extended Surface Models of SOFC Electrodes," *Journal of Power Sources*, 2014, 265: p. 282-290.
18. W. M. Harris, J. J. Lombardo, G. J. Nelson, B. Lai, S. Wang, J. Vila-Comamala, M. Liu, M. Liu and W. K. S. Chiu, "Three-Dimensional Visualization of Nickel Sulfide Formation in Ni-YSZ Solid Oxide Fuel Cell Anodes Subjected to Hydrogen Sulfide," *Scientific Reports*, 2014, 4: Article 5246.
17. A. P. Cocco†, G. J. Nelson†, W. M. Harris, A. Nakajo, J. J. Lombardo, T. D. Myles, A. M. Kiss and W. K. S. Chiu, "Three Dimensional Microstructural Imaging Methods for Energy Materials," *Physical Chemistry Chemical Physics*, 2013, 15(39): p. 16377-16407. (*Feature Article, Front Cover*)
16. G. J. Nelson, B. N. Cassenti, A. A. Peracchio and W. K. S. Chiu, "An Analytical Method for Dye-Sensitized Solar Cell Geometric Design," *Electrochimica Acta*, 2013, 90: p. 475-481.
15. A. M. Kiss, T. D. Myles, K. N. Grew, A. A. Peracchio, G. J. Nelson and W. K. S. Chiu, "Carbonate and Bicarbonate Ion Transport in Alkaline Anion Exchange Membranes," *Journal of the Electrochemical Society*, 2013, 160(9): p. F994-F999.
14. W. M. Harris, J. J. Lombardo, M. B. DeGostin, G. J. Nelson, H. Luebbe, J. A. Schuler, J. Van herle, J. C. Andrews, Y. Liu, P. Pianetta, Y. K. Chen, J. Wang and W. K. S. Chiu, "Influence of Poisoning Phases in the Neodymium Nickelate Solid Oxide Fuel Cell Cathode," *Solid State Ionics*, 2013, 237: p. 16-21.
13. M. E. Lynch, D. Ding, W. M. Harris, J. J. Lombardo, G. J. Nelson, W. K. S. Chiu and M. Liu, "Flexible Multiphysics Simulation of Porous Electrodes: Conformal to 3D Reconstructed Microstructures," *Nano Energy*, 2013, 2(1): p. 105-115.
12. G. J. Nelson, K. N. Grew, J. R. Izzo, Jr., J. J. Lombardo, W. M. Harris, A. Faes, A. Hessler-Wyser, J. Van herle, S. Wang, Y. S. Chu, A. V. Virkar and W. K. S. Chiu, "Three-Dimensional Microstructural Changes in the Ni-YSZ Solid Oxide Fuel Cell Anode During Operation," *Acta Materialia*, 2012, 60(8): p. 3491-3500.
11. G. J. Nelson, B. N. Cassenti, A. A. Peracchio and W. K. S. Chiu, "Microstructural Effects on Electronic Charge Transfer in Li-Ion Battery Cathodes," *Journal of the Electrochemical Society*, 2012, 159(5): p. A598-A603.
10. G. J. Nelson, B. N. Cassenti, A. A. Peracchio and W. K. S. Chiu, "Two-Dimensional Charge Transfer and Space Charge Effects in Extended Surface Solid Oxide Fuel Cell Electrodes," *Journal of Power Sources*, 2012, 205: p 48-56.

9. F. Abdeljawad, G. J. Nelson, W. K. S. Chiu and M. Haataja, "Redox Instability, Mechanical Deformation, and Damage Accumulation in Solid Oxide Fuel Cell Anodes: A Continuum Simulation Approach," *Journal of Applied Physics*, 2012, 112(3): p. 036102.
8. T. D. Myles, G. J. Nelson, A. A. Peracchio, W. K. S. Chiu, R. J. Roy, B. L. Murach and G. A. Adamson, "Species Transport in a High Pressure Oxygen Generating Proton Exchange Membrane Electrolyzer," *International Journal of Hydrogen Energy*, 2012, 37(17): p. 12451-12463.
7. W. K. S. Chiu, A. V. Virkar, F. Zhao, K. L. Reifsnider, G. J. Nelson, F. Rabbi and Q. Liu, "HeteroFoams: Electrode Modeling in Nano-structured Heterogeneous Materials for Energy Systems," *Journal of Fuel Cell Science and Technology*, 2012, 9: p. 011019.
6. W. M. Harris, G. J. Nelson, A. M. Kiss, J. R. Izzo, Jr., W. K. S. Chiu, Y. Liu, M. Liu, Y. S. Chu and S. Wang, "Nondestructive Volumetric 3-D Chemical Mapping of Nickel-Sulfur Compounds at the Nanoscale," *Nanoscale*, 2012, 4 (5): p. 1557 - 1560.
5. G. J. Nelson, A. A. Peracchio and W. K. S. Chiu, "Analytical Investigations of Varying Cross Section Microstructures on Charge Transfer in SOFC Electrodes," *Journal of Power Sources*, 2011, 196: p. 4695-4705.
4. G. J. Nelson, W. M. Harris, J. R. Izzo, Jr., K. N. Grew, W. K. S. Chiu, Y. S. Chu, J. Yi, J. C. Andrews, Y. Liu and P. Pianetta, "Three Dimensional Mapping of Nickel Oxidation States using Full Field X-ray Absorption Near Edge Structure Nanotomography," *Applied Physics Letters*, 2011, 98: p. 173109. (Featured in *APS Science 2011*)
3. G. J. Nelson, W. M. Harris, J. J. Lombardo, J. R. Izzo, Jr., W. K. S. Chiu, P. Tanasini, M. Cantoni, J. Van herle, C. Comninellis, J. C. Andrews, Y. Liu, P. Pianetta and Y. S. Chu, "Comparison of SOFC Cathode Microstructure Quantified using X-ray Nanotomography and Focused Ion Beam - Scanning Electron Microscopy," *Electrochemistry Communications*, 2011, 13 (6): p. 586-589.
2. T. D. Myles, A. M. Kiss, K. N. Grew, A. A. Peracchio, G. J. Nelson and W. K. S. Chiu, "Calculation of Water Diffusion Coefficients in an Anion Exchange Membrane Using a Water Permeation Technique," *Journal of the Electrochemical Society*, 2011, 158 (7): p. B790-B796.
1. G. J. Nelson and C. L. Haynes, "Continuum-level Solid Oxide Electrode Constriction Resistance Effects," *Journal of Power Sources*, 2008, 185 (2): p. 1168-1178.

*Peer Reviewed Conference Proceedings and Abstracts*

35. G. J. Nelson, L. J. Ausderau, J. R. Buckley, and Z. K. van Zandt, "3D Spectroscopic X-ray Imaging of Li-ion Battery Electrode Materials", *2016 Gordon Research Conference: Batteries*, Ventura, California, February 21-25, 2016.
34. G. J. Nelson, "Comparison of SOFC Performance Predictions Based on Analytical and Distributed Charge Transfer Models," *Proceedings of IMECE2015: 2015 ASME International Mechanical Engineering Congress and Exposition*, Houston, Texas, November 13-19, 2015.
33. A. Nakajo, A. M. Kiss, A. P. Cocco, W. M. Harris, M. B. DeGostin, F. Greco, G. J. Nelson, A. A. Peracchio, B. N. Cassenti, A. Deriy, S. Wang, Y. C. K. Chen-Wiegart, J. Wang, J. Van herle, W. K. S. Chiu, "Characterization of Cracks and Their Effects on the Effective Transport Pathways in Ni-YSZ Anodes after Reoxidation using X-Ray Nanotomography," Fourteenth International Symposium on Solid Oxide Fuel Cells (SOFC-XIV), Paper No. 231, Glasgow, Scotland, July 26-31, 2015 (*ECS Transactions* 68(1): p. 1069-1081, 2015).
32. M. B. DeGostin, A. Nakajo, G. J. Nelson, B. N. Cassenti, A. A. Peracchio, W. K. S. Chiu, "Closed Form Solutions to Investigate Ionic Conductivity in Porous Fuel Cell Electrode Microstructures," *Proceedings of the 1st Thermal and Fluid Engineering Summer Conference*, New York, New York, August 9-12, 2015.

31. J. R. Buckley, M. D. Denny, and G. J. Nelson, "Computed Tomography Characterization of a Porous Hybrid Motor Grain," *51st AIAA/SAE/ASEE Joint Propulsion Conference*, Orlando, Florida, July 27-29, 2015.
30. G. J. Nelson, "Multiscale Assessment of Charge and Mass Transfer in Solid Oxide Cells," *CHT-15: International Symposium on Advances in Computational Heat Transfer*, Piscataway, New Jersey, May 25-29, 2015.
29. Z. K. Van Zandt and G. J. Nelson, "Parametric Studies of Microstructural Performance Effects in Solid Oxide Cells," *Proceedings of IMECE2014: 2014 ASME International Mechanical Engineering Congress and Exposition*, Montreal, Canada, November 14-20, 2014.
28. A. Nakajo, M. Cantoni, M. B. DeGostin, A. P. Cocco, G. J. Nelson, A. A. Peracchio, B. N. Cassenti, W. K. S. Chiu, J. Van herle, "Degradation of LSM-YSZ Cathode during Exposure Tests Analyzed by Focused Ion Beam-Scanning Electron Microscopy," *65<sup>th</sup> Annual Meeting of the International Society of Electrochemistry*, Lausanne, Switzerland, August 31-September 5, 2014.
27. G. J. Nelson, "X-ray Nanotomography Techniques for Li-ion Battery Electrode Materials," *17<sup>th</sup> U.S. National Congress on Theoretical and Applied Mechanics*, East Lansing, Michigan, June 15-20, 2014.
26. G. J. Nelson, "Performance Impacts of Tailored Surface Geometry in Li-Ion Battery Cathodes," *Proceedings of IMECE2013: 2013 ASME International Mechanical Engineering Congress and Exposition*, San Diego, California, November 15-21, 2013.
25. W. M. Harris, J. J. Lombardo, B. Lai, G. J. Nelson, S. Wang, J. Vila-Comamala, M. Liu, M. Liu and W. K. S. Chiu, "Examining Effects of Sulfur Poisoning on Ni/YSZ Solid Oxide Fuel Cell Anodes Using Synchrotron-Based X-ray Imaging Techniques," *Proceedings of IMECE2013: 2013 ASME International Mechanical Engineering Congress and Exposition*, San Diego, California, November 15-21, 2013.
24. G. J. Nelson, B. N. Cassenti, A. A. Peracchio and W. K.S. Chiu, "An Analytical Method to Assess Microstructure in Li-Ion Battery Cathodes," *Proceedings of IMECE2012: 2012 ASME International Mechanical Engineering Congress and Exposition*, Houston, Texas, November 9-15, 2012.
23. A. Nakajo, G. J. Nelson, M. B. DeGostin, T. D. Myles, A. A. Peracchio and W. K. S. Chiu, "Characterization of Solid Oxide Fuel Cell Materials Based on Microstructural Skeletonization," *Proceedings of IMECE2012: 2012 ASME International Mechanical Engineering Congress and Exposition*, Houston, Texas, November 9-15, 2012.
22. A. M. Kiss, T. D. Myles, K. N. Grew, A. A. Peracchio, G. J. Nelson and W. K. S. Chiu, "Carbonate and Bicarbonate Ion Transport in Alkaline Anion Exchange Membranes," *PRiME 2012: Pacific Rim Meeting on Electrochemical and Solid-State Science*, Honolulu, Hawaii, October 7-12, 2012.
21. J. J. Lombardo, B. Lai, W. M. Harris, G. J. Nelson, S. Wang, M. Liu, M. Liu and W. K. S. Chiu, "The Role of Sulfur in the Porous Cermet Solid Oxide Fuel Cell Anode Microstructure," *Proceedings of HT2012: 2012 ASME Summer Heat Transfer Conference*, San Juan, Puerto Rico, July 8-12, 2012.
20. A. P. Cocco, W. M. Harris, G. J. Nelson, J. J. Lombardo and W. K. S. Chiu, "X-Ray Methods for Composition-Sensitive 3D Mapping of Solid Oxide Fuel Cell Electrode Microstructures," *Proceedings of the 45<sup>th</sup> Power Sources Conference*, Las Vegas, Nevada, June 11-14, 2012.
19. A. M. Kiss, T. D. Myles, K. N. Grew, A. A. Peracchio, G. J. Nelson and W. K. S. Chiu, "Predicting Carbonate Species Ionic Conductivity in Alkaline Anion Exchange Membranes," *Proceedings of the 45<sup>th</sup> Power Sources Conference*, Las Vegas, Nevada, June 11-14, 2012.
18. G. J. Nelson, A. A. Peracchio, B. N. Cassenti and W. K. S. Chiu, "Investigation of the Impact of Sintering on SOFC Charge Transfer," *Proceedings of IMECE2011: 2011 ASME International Mechanical Engineering Congress and Exposition*, Denver, Colorado, November 11-17, 2011.

17. G. J. Nelson, J. R. Izzo, Jr., J. J. Lombardo, W. M. Harris, A. P. Cocco, W. K. S. Chiu, K. N. Grew, A. Faes, A. Hessler-Wyser, J. Van herle, Y. S. Chu and S. Wang, "X-ray Imaging and Analysis of 3D Microstructural Changes in Aged Ni-YSZ Anodes," Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII), *219th ECS Meeting*, Paper No. 860, Montreal, Canada, May 1-6, 2011 (*ECS Transactions* 35 (1): p. 1323-1327, 2011).
16. G. J. Nelson, A. A. Peracchio, B. N. Cassenti and W. K. S. Chiu, "Analytical Models for SOFC Electrodes with Variable Cross-Section Microstructures," Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII), *219th ECS Meeting*, Paper No. 985, Montreal, Canada, May 1-6, 2011 (*ECS Transactions* 35(1): p. 1315-1321, 2011).
15. G. J. Nelson, W. M. Harris, J. J. Lombardo, J. R. Izzo, Jr., W. K. S. Chiu, P. Tanasini, M. Cantoni, J. Van herle, C. Comninellis, J. C. Andrews, Y. Liu, P. Pianetta and Y. S. Chu, "Comparison of X-ray Nanotomography and FIB-SEM in Quantifying the Composite LSM/YSZ SOFC Cathode Microstructure," Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII), *219th ECS Meeting*, Paper No. 706, Montreal, Canada, May 1-6, 2011 (*ECS Transactions* 35(1): p. 2417-2421, 2011).
14. G. J. Nelson, W. M. Harris, J. R. Izzo, Jr., K. N. Grew, W. K. S. Chiu, Y. S. Chu, J. Yi, J. C. Andrews, Y. Liu and P. Pianetta, "3D Imaging of Nickel Oxidation States using Full Field X-ray Absorption Near Edge Structure Nanotomography," Twelfth International Symposium on Solid Oxide Fuel Cells (SOFC-XII), *219th ECS Meeting*, Paper No. 859, Montreal, Canada, May 1-6, 2011 (*ECS Transactions* 35(1): p. 1315-1321, 2011).
13. W. M. Harris, G. J. Nelson, J. J. Lombardo, A. P. Cocco, J. R. Izzo, Jr., W. K. S. Chiu, P. Tanasini, J. Van herle, C. Comninellis, J. C. Andrews, Y. Liu, P. Pianetta and Y. S. Chu, "Analysis of Solid Oxide Fuel Cell LSM-YSZ Composite Cathodes with Varying Starting Powder Sizes," *Proceedings of IMECE2011: 2011 ASME International Mechanical Engineering Congress and Exposition*, Denver, Colorado, November 11-17, 2011.
12. W. M. Harris, G. J. Nelson, J. R. Izzo, Jr., K. N. Grew, W. K. S. Chiu, Y. S. Chu, J. Yi, J. C. Andrews, Y. Liu and P. Pianetta, "Full Field Imaging of Nickel Oxidation States in Solid Oxide Fuel Cell Anode Materials by XANES Nanotomography," *Proceedings of ESFuelCell 2011: 2011 Energy Sustainability Conference & Fuel Cell Conference*, Washington, D.C., August 7-10, 2011.
11. A. M. Kiss, T. D. Myles, K. N. Grew, A. A. Peracchio, G. J. Nelson and W. K. S. Chiu, "Calculating Hydroxide Conductivity in Alkaline Anion Exchange Membranes," *220th ECS Meeting*, Boston, Massachusetts, October 9-14, 2011.
10. T. D. Myles, G. J. Nelson, A. A. Peracchio, W. K. S. Chiu, R. J. Roy, B. L. Murach and G. A. Adamson, "Species Transport in the High Differential Pressure Oxygen Generating Electrolyzer Membrane," *220th ECS Meeting*, Boston, Massachusetts, October 9-14, 2011.
9. G. J. Nelson, K. N. Grew, J. R. Izzo, Jr., A. A. Peracchio and W. K. S. Chiu, "Nondestructive Imaging and Analysis of Solid Oxide Fuel Cell Anodes," *Proceedings of IMECE2010: 2010 ASME International Mechanical Engineering Congress and Exposition*, Vancouver, British Columbia, November 12-18, 2010.
8. J. R. Izzo, Jr., K. N. Grew, G. J. Nelson, A. A. Peracchio and W. K. S. Chiu, "X-ray 3-D Imaging of Solid Oxide Fuel Cell Electrodes for Phase Reconstruction and Analysis," *2010 European Fuel Cell Forum*, Lucerne, Switzerland, June 29-July 2, 2010.
7. G. J. Nelson, C. L. Haynes and W. J. Wepfer, "A Fractal Approach for Modeling SOFC Electrode Mass Transport," *Proceedings of IMECE2009: 2009 ASME International Mechanical Engineering Congress and Exposition*, Lake Buena Vista, Florida, November 13-19, 2009.

6. G. J. Nelson, C. L. Haynes and W. J. Wepfer, "Performance Metrics for Solid Oxide Fuel Cell Cross-section Design," *Proceedings of FuelCell2009: 2009 ASME International Fuel Cell Science, Engineering and Technology Conference*, Newport Beach, California, June 8-10, 2009.
5. G. J. Nelson, C. L. Haynes and C. J. Miller, "Dilute Ethanol Fueled SOFCs: A Symbiotic Solution Strategy," *Proceedings of FuelCell2009: 2009 ASME International Fuel Cell Science, Engineering and Technology Conference*, Newport Beach, California, June 8-10, 2009.
4. G. J. Nelson and C. L. Haynes, "Parametric Studies of Constriction Resistance Effects upon Solid Oxide Cell Transport," *Proceedings of IMECE2006: 2006 ASME International Mechanical Engineering Congress and Exposition*, Chicago, Illinois, November 5-10, 2006.
3. M. Radovic, E. Lara-Curzio and G. J. Nelson, "Fracture Toughness and Slow Crack Growth Behavior of Ni-YSZ and YSZ as a Function of Porosity and Temperature," *Proceedings of the 30th International Conference on Advanced Ceramics and Composites*, Cocoa Beach, Florida, January 22-27, 2006.
2. J. A. Salem, E. Lara-Curzio, M. Radovic and G. J. Nelson, "Using the Double Torsion Test Method to Determine the Fracture Toughness of Thin Ceramic Films", *Proceedings of The 30th Annual International Conference on Advanced Ceramics and Composites*, Cocoa Beach, Florida, January 22-27, 2006.
1. G. J. Nelson and C. L. Haynes, "Localized Constriction Resistance Effects upon SOFC Transport Phenomena," *Proceedings of IMECE2005: 2005 ASME International Mechanical Engineering Congress and Exposition*, Orlando, Florida, November 5-11, 2005.

**Presentations:**

12. NASA Glenn Research Center, Photovoltaic and Electrochemical Systems Branch, Cleveland, OH September 2015
11. University of Alabama, Department of Electrical and Computer Engineering, Tuscaloosa, AL March 2014.
10. University of Alabama in Huntsville, Engineering Advisory Board Meeting, Huntsville, AL, March 2013.
9. University of Alabama in Huntsville, Fall 2012 Materials Science Symposium, Huntsville, AL, December 2012.
8. CFD Research Corporation, Huntsville, AL, October 2012.
7. University of Alabama in Huntsville, Department of Mechanical and Aerospace Engineering, Huntsville, AL, April 2012.
6. University of North Texas, Department of Mechanical and Energy Engineering, Denton, TX, March 2012.
5. University of Iowa, Department of Mechanical and Industrial Engineering, Iowa City, IA, February 2012.
4. Texas A&M University, Department of Mechanical Engineering, College Station, TX, February 2012.
3. Colorado School of Mines, Division of Engineering, Golden, CO, November 2011.
2. Connecticut Center for Clean Energy Engineering Joule Fellows, Storrs, CT, July 2010.
1. University of Connecticut, Department of Mechanical Engineering, Storrs, CT, July 2009.

**Research Funding:**

14. *CAREER: In Situ Observation of Coupled Transport and Degradation in Battery Electrodes*, National Science Foundation; Award Dates: 5/2015-4/2020; PI: G. J. Nelson; Amount: \$502,491.

13. *Mini-Symposium: Multiphysics Coupling in Energy Storage*, National Science Foundation; Award Dates: 9/2015-8/2016; PI: G. J. Nelson; Co-PI: P. P. Mukherjee (Texas A&M University), W. K. S. Chiu (University of Connecticut), I. Avdeev (University of Wisconsin-Milwaukee); Amount: \$5,046.
12. *Innovative Propulsion and Power Technology Support*, Missile Defense Agency; Award Dates: 4/2015-3/2016; PI: R. A. Frederick; Co-PI: J. Cassibry, D. Lineberry, G. J. Nelson, R. Tyson; Amount: \$100,000 (PI Share).
11. *Affordable Additive Manufacturing of Electrochemical Energy Conversion Devices*, 2015 University of Alabama in Huntsville Research and Creative Experiences for Undergraduates (RCEU) Program; PI: G. J. Nelson (Faculty Advisor); 5/2015-8/2015; Amount: \$3,200.
10. *In Situ Neutron Imaging of Enzyme-Based Electrochemical Cells*, University of Alabama in Huntsville New Faculty Research Program; Award Dates: 1/2015-12/2015; PI: G. J. Nelson; Amount: \$10,000.
9. *X-ray Diffraction System for Characterization of Energy Materials*, University of Alabama in Huntsville Research Infrastructure Fund; Award Dates: 1/2015-1/2016; PI: G. J. Nelson, Co-PI: Yu Lei; Amount: \$92,850.
8. *Collaborative Research: Mesoscale Investigation of Microstructure-Transport Interaction of High-Capacity Electrodes for Energy Storage*, National Science Foundation; Award Dates: 9/2014-8/2017; PI: G. J. Nelson, P. P. Mukherjee (Texas A&M University); Amount: \$202,413 (PI Share).
6. *UAH Innovative Propulsion Technology Consortium*, Missile Defense Agency; Award Dates: 4/2014-3/2015; PI: R. Tyson; Co-PI: J. Cassibry, R. A. Frederick, D. Lineberry, G. J. Nelson, N. Slegers; Amount: \$45,000 (PI Share).
5. *Assessing Solid Oxide Electrolyzer Degradation Driven by Gas Composition*, National Aeronautics and Space Administration; Award Dates: 1/2013-2/2016; PI: G. J. Nelson; Amount: \$47,839 (External) \$77,643 (Internal). Note: Award renewed for third year.
4. *Analytical and Numerical Investigation of Oxidation Resistant Heating Elements*, University of Alabama in Huntsville Industry/University Graduate Student Research Program; Award Dates: 1/2014-5/2014; PI: G. J. Nelson; Amount: \$12,147.
3. *Assessing Microstructural Evolution Mechanisms in Thermoelectric Materials*, Oak Ridge Associated Universities Ralph E. Powe Junior Faculty Enhancement Award; Award Dates: 5/2013-12/2014; PI: G. J. Nelson; Amount: \$4,999 (External) \$9,953 (Internal).
2. *Effects of Humidity and Temperature on Bio-Battery Performance*, University of Alabama in Huntsville Research Infrastructure Fund; Award Dates: 4/2013-3/2014; PI: G. J. Nelson, Co-PI: D. B. Landrum; Amount: \$13,427.
1. *In Situ Imaging and Analysis of Solid Oxide Fuel Cell Anodes during Degradation*, National Science Foundation; Award Dates: 10/2011-9/2014; PI: W. K. S. Chiu, Co-PI: G. J. Nelson; Amount: \$296,489.

#### **Student Advising and Mentoring Activities:**

*Graduate Students (University of Alabama in Huntsville):* Logan Ausderau, Joseph Buckley, Annalisa Fowler, Piyush Jibhakate, Zachary van Zandt

*Undergraduate Researchers (University of Alabama in Huntsville):* Joshua Grumbach, Ryan Longchamps, Erin Looney, SeungYoon Shin

*Undergraduate Researchers (Other Institutions):* Joselyn Baety (Georgia Institute of Technology), Kyle Bagshaw (University of Connecticut), Matthew Degostin (University of Connecticut), Cameron Miller (Georgia Institute of Technology)

### **Courses Taught, University of Alabama in Huntsville:**

- MAE 695 Conduction and Diffusion; Fall 2013
- MAE 495 Electrochemical Energy Conversion and Storage; Fall 2015
- MAE 450 Introduction to Heat Transfer; Fall 2012, Spring 2013, Spring 2014
- MAE 450L Introduction to Heat Transfer Laboratory; Fall and Spring 2013-2015
- MAE 341 Thermodynamics I; Spring 2013, Fall 2014, Spring 2015

### **Professional Societies:**

- American Society of Mechanical Engineers, 2002 to Present
- The Electrochemical Society, 2011 to Present
- Engineers Without Borders, Member, 2008 to 2012

### **Professional Service Activities:**

- *Guest Editor:* ASME Journal of Electrochemical Energy Conversion and Storage, 2015-2016
- *Chair:* ASME Advanced Energy Systems Division, Electrochemical Energy Conversion and Storage Technical Committee (Vice Chair for 2013-2014), Member 2008 to Present
- *Member:* ASME Advanced Energy Systems Division, Executive Committee, 2012 to Present
- *Member:* ASME Heat Transfer Division, K-15 Transport Phenomena in Manufacturing and Materials Processing Technical Committee, 2011 to Present
- *Technical Program Chair:* ASME 2016 International Fuel Cell Science, Engineering and Technology Conference, Charlotte, North Carolina, June 26-30, 2016
- *Technical Program Co-Chair:* ASME 2015 International Fuel Cell Science, Engineering and Technology Conference, San Diego, California, June 28-July 2, 2015
- *Track Organizer:* ASME 2014 International Mechanical Engineering Congress and Exposition, Track 7: Energy, Montreal, Canada, November 14-20, 2014
- *Topic Organizer (2 Topics):* ASME 2014 International Mechanical Engineering Congress and Exposition, Topic 7-9: Electrochemical Energy Conversion and Storage, Topic 7-10: Fuel Cell Systems Design and Application, Montreal, Canada, November 14-20, 2014
- *Topic Co-Organizer (2 Topics):* ASME 2013 International Mechanical Engineering Congress and Exposition, Topic 7-4: Electrochemical Energy Conversion and Storage, Topic 7-5: Fuel Cell Systems Design and Application, San Diego, California, November 15-21, 2013
- *Session Organizer (2 Technical Sessions):* ASME 2013 International Mechanical Engineering Congress and Exposition; Electrochemical Energy Conversion and Storage, Session 7-4-2: Advanced Electrochemical Storage Concepts II; Fuel Cell Systems Design and Application, Session 7-5-1: High Temperature Fuel Cells; San Diego, California, November 15-21, 2013
- *Session Organizer (3 Technical Sessions):* ASME 2013 International Fuel Cell Science, Engineering and Technology Conference; Session 2-4-1: Modeling, Design, and Optimization for High Temperature Fuel Cells: I. Cell Level Modeling; Session 2-4-2: Modeling, Design, and Optimization for High Temperature Fuel Cells: II. Stack/System Level Modeling; Session 2-5-2: Integrated Energy System Design; Minneapolis, Minnesota, July 14-19, 2013
- *Session Organizer (3 Technical Sessions):* ASME 2012 International Mechanical Engineering Congress and Exposition, Electrochemical Energy Conversion and Storage, Session 6-33-1: Li-Ion Batteries I, Session 6-33-2 Li-Ion Batteries II, Session 6-33-3: Energy Storage, Houston, Texas, November 9-15, 2012



- *Session Organizer:* ASME 2011 International Mechanical Engineering Congress and Exposition, Energy Systems: Analysis, Thermodynamics, and Sustainability, Session 2-8-4: High Temperature Fuel Cells, Denver, Colorado November 11-17, 2011
- *Session Organizer:* ASME 2011 International Energy Sustainability Conference and International Fuel Cell Science, Engineering and Technology Conference, Session 1-7-1: Thermofluids and Thermodynamics of Energy Systems, Washington, DC, August 7-10, 2011
- *Session Organizer (3 Technical Sessions):* ASME 2010 International Mechanical Engineering Congress and Exposition, Energy Systems: Analysis, Thermodynamics, and Sustainability, Session 7-2-1: Fundamentals of Thermodynamics and Thermoconomics I, Session 7-4-4: Exergy and Second Law Analysis, Session 7-5-4: PEM SOFC System Analysis, Vancouver, British Columbia, November 12-18, 2010
- *Session Co-Organizer:* ASME 2009 International Mechanical Engineering Congress and Exposition, Energy Systems: Analysis, Thermodynamics, and Sustainability, Session 7-6-4: Molten Carbonate & Solid Oxide Fuel Cell Analysis, Lake Buena Vista, Florida November 13-19, 2009
- *Reviewer:* Applied Physics A; ASME Journal of Fuel Cell Science and Technology; International Journal of Heat and Mass Transfer; Journal of the Electrochemical Society; Journal of Power Sources; ASME Fuel Cell Science, Engineering and Technology Conference; ASME International Energy Sustainability Conference; ASME International Mechanical Engineering Congress and Exposition, Advanced Energy Systems
- *Final Project Presentation Judge:* Leadership Education And Development (LEAD) Summer Engineering Institute (2008, Inaugural Year for LEAD Engineering Program)
- *Grand Awards Judge:* Intel International Science and Engineering Fair, 2008

**Prior Research Experience:**

**University of Connecticut, Department of Mechanical Engineering** 10/09 to Present  
**Assistant Research Professor**  
**In the Research Lab of Professor Wilson K. S. Chiu**  
 Storrs, Connecticut

- Primary research focused on modeling of charge transport phenomena within solid oxide fuel cell (SOFC) electrode microstructures. An analytical model was developed to describe the influence of microstructural geometry on solid phase ionic transport in the presence of charge transfer reactions at solid-pore boundaries. Finite element models were employed to benchmark the analytical model and assess the influence of multi-dimensional transport and space charge effects within the microstructure. A suite of dimensionless parameter was developed for microstructural performance assessment. Network analysis approaches are currently being explored to address more complex interconnected electrode microstructures. The extension of this modeling approach to other electrochemical systems is in development.
- Planned and performed x-ray microscopy experiments at multiple synchrotron light sources in support of research efforts addressing microstructural characterization of solid oxide fuel cell components. These experiments focused on expanding the current understanding of SOFC degradation mechanisms and developing three-dimensional elemental and chemical mapping capabilities for common and novel SOFC materials. Primary techniques employed included absorption contrast and x-ray absorption near edge structure (XANES) nanotomography. Additional work included participation in x-ray fluorescence and x-ray diffraction experiments. Assisted in the writing of competitive proposals for access to experimental facilities.

- Participated in efforts to characterize transport in polymer membranes through two projects: modeling of water transport in high differential pressure electrolyzer membranes and determining the conductivity in proton and anion exchange membranes. In both cases, the dusty-fluid model was applied to characterize membrane operation. The former project was completed in collaboration with Hamilton-Sundstrand in an effort to develop a model to support membrane and system design. The latter project is an ongoing effort to apply experiments and models to understand the interplay between membrane water and ion transport.

**Georgia Institute of Technology/Georgia Tech Research Institute**

4/04 to 10/09

Atlanta, Georgia

- Primary research involved the study of transport phenomena in solid oxide cells through analytical and computational means with a focus on solid oxide fuel cells and high temperature electrolysis applications. The effects of component and microstructural geometry on diffusive transport phenomena and the resulting design implications were emphasized. Additional modeling activities examined the impacts of cell degradation on ionic transport. Primary modeling methods included finite element analysis, classical analytical methods, computational programming, and design of experiments (DOE) methods.
- Developed transient models of solid oxide and polymer electrolyte membrane regenerative fuel cell (RFC) systems for high altitude long endurance (HALE) aircraft. Both combined and discrete RFC systems were modeled. Research was performed through collaborative efforts with colleagues at Florida A&M University.
- Additional work included systems level energy analysis of dilute ethanol production for use as a fuel in stationary SOFC power generation applications. Assisted in the advisement of two undergraduate research assistants in directed individual study programs.

**Oak Ridge National Laboratory**

6/05 to 8/05

Oak Ridge, Tennessee

- Studied fracture and slow crack growth characteristics of ceramic and ceramic-metal composite materials for high temperature applications. Research was performed in the High Temperature Materials Laboratory through the Higher Education Research Experience (HERE) program.

**Atomix, LLC**

11/02 to 4/04

Atlanta, Georgia

- Performed research for an established professional engineer in the areas of energy systems and fluid mechanics involving nanofluids and cavitation.

**Georgia Institute of Technology/Georgia Tech Research Institute**

1/03 to 5/03

Atlanta, Georgia

- Participated in the design and performance of experiments for characterization and optimization of a hydrocarbon fuel processor for PEM fuel cells.

**Prior Teaching Experience:**

**Georgia Institute of Technology**

Atlanta, Georgia

Head Graduate Teaching Assistant

1/07 to 12/08

- *ME 3057 Experimental Methodology and Technical Writing* (Six Semesters): Performed laboratory set-up, teaching, and supervision; weekly grading; course administration; maintenance of course websites using course management software; monitoring of online course discussions; and management of 10+ graduate teaching assistants for an undergraduate laboratory course containing 100+ students. Assisted with course evaluation and compiled student work examples for ABET assessment records. Performed course lectures in fulfillment

of Teaching Practicum requirements (Fall 2007). Oversaw the transition between online course management software platforms (Spring 2008). Developed and performed TA training in conjunction with the upgrade and deployment of a new microprocessor platform used in laboratory experiments (Fall 2008).

Graduate Teaching Assistant

8/04 to 12/06

- *ME 3057 Experimental Methodology and Technical Writing* (Four Semesters): Taught laboratory sessions containing 10-15 students, performed weekly grading, and monitored online course discussions for an undergraduate laboratory course.
- *ME 4055 Experimental Engineering* (One Semester): Supervised two teams of undergraduates working on a semester-long project to characterize the performance of a direct methanol fuel cell operating under pulsed fuel flow conditions.

**Prior Industry Experience:**

**Pratt and Whitney**

East Hartford, Connecticut and West Palm Beach, Florida

Engineering Co-op

9/98 to 5/01 (Five school terms)

- Combustors, Augmentors, and Nozzles, Structural and Thermal Finite Element Analysis
- General Machining, Manufacturing Engineering
- Propulsion Systems Analysis, Fault Detection and Accommodation Control Logic
- Compression Systems, Mechanical Design and Project Engineering
- Customer Support & Services, Non-complex Engine Overhaul and Support Tooling