

Marc E. Baumgardner, PhD

Assistant Professor of Mechanical Engineering

CONTACT INFORMATION	Gonzaga University Mechanical Engineering 502 E. Boone Ave. Spokane, WA 99258	Phone: (509) 313.5513 Office: Herak 302B E-mail: baumgardner@gonzaga.edu Website: http://connect.gonzaga.edu/baumgardner
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EDUCATION	PhD, Mechanical Engineering Awarded: May 2014 Dissertation: "Characterizing Fuel Reactivity in Advanced Internal Combustion Engines" Advisor: Anthony J. Marchese	Colorado State University Fort Collins, CO
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	B.S. Chemical Engineering Awarded: May 2005	Georgia Institute of Technology Atlanta, GA
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	B.S. Chemistry Awarded: May 2005	University of West Georgia Carrollton, GA
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EMPLOYMENT	Assistant Professor of Mechanical Engineering Gonzaga University, Spokane, WA	September 2015 to Present
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	Postdoctoral Fellow Graduate Research Assistant Teaching Assistant Colorado State University, Dept. of Mechanical Engineering	May 2014 to Aug 2015 August 2010 to May 2014 August 2013 to December 2013 Fort Collins, CO
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	Process Specialist , <i>Gasoline Technology Services</i> Field Advisor , <i>Field Operating Services</i> Development Engineer , <i>Naphtha Catalyst R&D</i> UOP, a Honeywell Company, Des Plaines, IL	February 2008 to August 2010 September 2006 to January 2008 June 2005 to September 2006
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EXPERIENCE	<u>Assistant Professor, Gonzaga University</u>	<u>September 2015 to Present</u>
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I am currently an Assistant Professor of Mechanical Engineering specializing in the thermal sciences. I teach courses in Thermodynamics, Fluid Mechanics, and Heat Transfer. My research interests span from fundamental combustion sciences to energy efficiencies of hybrid combustion-renewable systems. Current research topics include biofuels, biomass cookstoves, and advanced internal combustion engine concepts such as dual fuel engines. More information on my research can be found on my website: <http://connect.gonzaga.edu/baumgardner>.

	<u>Postdoctoral Researcher, CSU</u>	<u>May 2014 to August 2015</u>
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As a Postdoctoral Fellow under Prof. Anthony Marchese and Prof. Daniel Olsen I worked on a variety of projects spanning fundamental combustion and laser-based research, product design and development, and industrial field work. The following is a brief summary of each major project.

Rapid Compression Machine Studies: An RCM is a device which simulates the ideal compression stroke of an internal combustion engine; as such it can be used to study a variety of combustion phenomena. As part of my graduate and post-graduate work, I was in charge of the day-to-day RCM activities as well as the design and installation of ancillary experimental systems. There were two major RCM studies carried out during my tenure at CSU. The first was a project with the University of California San Diego wherein the ignition characteristics of producer gas blends were examined to better understanding the chemical kinetics of producer gas combustion with a focus on updating chemical kinetic mechanisms. The second study was a Chevron-funded project focused on laser ignition of natural gas blends. I was responsible for supervising a Masters Student for both of these studies.

Cookstove Studies: As part of a DOE-funded study (Award No.DE-EE0006086), I was a member of a multidisciplinary team between CSU and Princeton University focused on achieving Tier 4 emissions and efficiency in biomass cookstoves. Specifically my role was to assist with the experimental design, fabrication, and development of gasifier cookstoves.

Exhaust Gas Catalyst Studies: This work was a Pipeline Research Council International (PRCI) funded project investigating the degradation of oxidation catalysts on the exhaust of 2-stroke lean-burn natural gas engines at a compressor station. My role in this project involved supervising a Masters Student, design and field-installation of equipment, and setup of catalyst testing laboratory protocols. As a result of field testing, we were able to show a correlation between catalyst poisoning rates and lube-oil carry over from the engine to the exhaust gas and subsequent deposition on the exhaust catalyst.

Graduate Research Assistant, CSU August 2010 to May 2014

As a Graduate Research Assistant under Prof. Anthony Marchese my research focus was primarily fundamental combustion research and modeling with a focus on internal combustion engines. Specifically I explored the various fuel reactivity metrics (e.g. octane number, cetane number, and methane number) and examined how alternative fuels such as n-butanol altered combustion in both traditional and advanced engines such as Homogeneous Charge Compression Ignition (HCCI) and Reactivity Controlled Compression Ignition engines (dual fuel engine). As a GRA I supervised a team of Senior Mechanical Engineering students in converting a John Deere Tractor engine to run one of the cylinders in HCCI mode (their senior design project).

Process Specialist, UOP February 2008 to August 2010

As a Process Specialist for the Gasoline Technology Services my role was primarily that of a Technical Expert for existing and new refinery process units. Duties included: internal and external PFD and P&ID reviews, customer expectation meetings, project management assisting field personnel during construction, and startup with the goal of meeting performance guarantees. My customer base consisted of over 100 refineries throughout the world and approximately 10-20% of my time was field-work: both domestically and internationally. I also worked with the UOP Sales Dept. to disseminate presentations and information for both internal and external customers, as well as product performance estimates and reviews of new products with the goal of following performance in order to determine commercial viability, industry acceptance, and ensure continued commercial success. Lastly, I was co-instructor for multiple Internal and External Customer Technical Trainings, which typically lasted 1-2 weeks of 6-8hr/day instruction.

Field Advisor, UOP September 2006 to January 2008

As a Field Advisor I was experienced in working throughout the U.S., South America, Europe, and Asia (China). My time was 100% travel and my field experience was predominantly in gasoline production technologies: Continuous Catalytic Reformers (CCR), Fixed-Bed Reformers, and Isomerization units. Typical duties were creating and troubleshooting mass and energy balances and unit operations. I used P&ID, PFDs, and UOP Engineering standards to compare with contractor and customer drawings and specifications for new and existing operating units (refineries). I worked to direct teams of refinery, contract, and UOP personnel in various new-unit and maintenance activities including scheduling, inspection, and various technical aspects of the job. Lastly I was responsible for managing/training several UOP-trainees in aforementioned areas (e.g. Fixed-Bed Reforming and Isomerization units).

Development Engineer, UOP June 2005 to September 2006

As a Development Engineer in the Naphtha Reforming technologies (gasoline production), I managed up to 4 pilot plants at any given time. My duties included scheduling experiments, gathering, interpreting, and reporting data. I also worked with pilot plant operators and data support groups such as mass spectrometry, computer modeling, and catalyst research groups.

I tested, screened, and compared current, developing, and experimental catalysts. I also analyzed customer data and compared it to analytical models to determine product performance and to assist in troubleshooting efforts. I was also a member of a cross-disciplinary team to develop a new product portfolio (Naphtha Isomerization catalyst). Team members included R&D, Marketing, and Sales. I wrote internal research papers comparing UOP catalysts to their competitors; including research of third party test results, competitors claims, sales/marketing data, customer/industry data, and internal testing and knowledge.

GRANTS,
FELLOWSHIPS,
HONORS, &
AWARDS

Gonzaga University McDonald Work Award Fall 2016 to Spring 2017
Gonzaga University, Spokane, WA
Received **\$2,368** in funding to hire two students as Research Assistants to investigate biogas and liquid biofuels in the micro-reactor setup.

Gonzaga Research Council Award Summer 2017
Gonzaga University, Spokane, WA
Received **\$1,950** in funding for materials to expand the capabilities of the micro-reactor setup to examine a wider array of fuels (increased number of gaseous fuels as well as liquid fuels).

Gonzaga University McDonald Work Award Fall 2016 to Spring 2017
Gonzaga University, Spokane, WA
Received **\$2,368** in funding to hire two students as Research Assistants to investigate the application of low-cost optical diagnostic techniques in analyzing biogas flames.

Gonzaga Research Council Award Summer 2016
Gonzaga University, Spokane, WA
Received **\$2,000** in funding for materials to improve the gas-mixing manifold and expand the number of gases that can be accommodated in my current laboratory setup.

Summer research support through the Gonzaga KEEN Grant Summer 2016
Gonzaga University, Spokane, WA
Received **\$15,000** in funding for myself and two students to design and build an experimental setup for the investigation of chemical kinetics and exhaust emissions of biogas combustion.

National Science Foundation Research Grant Summer 2015 to Summer 2018
Received (as Co-PI) **\$300,000** in funding for the investigation of dual fuel combustion in the context of a Rapid Compression Machine.
Ref: Marchese, A. J. and **Baumgardner, M.E.** (2014). *Autoignition of Liquid Hydrocarbon Droplets in Lean, High Pressure Natural Gas Mixtures Using a Rapid Compression Machine.* NSF RFP CBET - COMBUSTION, FIRE, & PLASMA SYS. NSF Proposal No.1510550. Awarded. November 2014. \$300,000.

Teacher Outreach Program Grant Spring 2015 to Spring 2016
Central States Section of the Combustion Institute
Co-wrote a grant with a high-school Physics teacher who received **\$5,000** in funding to develop a course module on combustion. Traveled to the school (Kenwood High School, Chicago, IL) to present to students and perform experiments with small-scale rockets (Estes).
Ref: Roberts, J.M. and Baumgardner, M.E. (2015). *The Power of Rockets.* A Central States Section of the Combustion Institute Grant Proposal. Awarded. February 2015. \$5,000.

C2B2 SEED Scholar Grant Fall 2011 to Fall 2012
Colorado Center for Biofuels and Biorefining
Received **\$35,000** for stipend and materials to further my graduate work investigating the effect that bio-alcohols fuel blends have in combustion engines.
Ref: Baumgardner, M.E. and Marchese, A.J. (2011). *Targeted chemical mechanism modification for Bio-Alcohol/FAME Blends for use in traditional and advanced combustion applica-*

tions. Colorado Center for Biofuels and Biorefining Seed Scholar Program. Grant No.11-6. Awarded. September 2011. \$35,000.

C2B2 Chevron Grant Fellowship

Fall 2011 to Fall 2012

Received **\$16,000** for stipend and materials to further my graduate work investigating the effect that bio-alcohols fuel blends have in combustion engines.

Ref: Baumgardner, M.E. and Marchese, A.J. (2011). *Targeted chemical mechanism modification for Bio-Alcohol/FAME Blends for use in traditional and advanced combustion applications*. Colorado Center for Biofuels and Biorefining-Chevron Grant Fellowship. Grant No.11-14-GF. Awarded. August 2011. \$16,000.

NSF IGERT Fellowship

Fall 2010 to Fall 2012

Colorado State University Received **\$70,000** in stipend as a fellow in the [Multidisciplinary Approaches to Sustainable BioEnergy](#) PhD program, which incorporated cross-disciplinary teamwork, courses in multiple disciplines, and research projects that spanned at least two focus areas.

Six Sigma Green Belt Certified

2009

UOP, a Honeywell Company

PROFESSIONAL
WORKSHOPS &
SCHOOLS

Princeton Combustion Summer School

Summer 2011 and 2012

Princeton University, Princeton, New Jersey

I have twice attended (2011 and 2012) the prestigious combustion summer school hosted by Princeton University (<http://www.princeton.edu/cefrcc/combustion-summer-school/>). The goal of this program is to bring together the top graduate combustion students in the country for a week-long session of community and instruction from some of the top combustion scientists in the world.

1st International RCM Workshop

Fall 2012

Argonne National Laboratory The focus of this workshop was to share information, data, and experiences from rapid compression machines (RCM) across the world. RCMs are one of the core combustion research instruments and yet much work is still needed to resolve some key differences observed between various research groups.

SERVICE TO THE
UNIVERSITY

Gonzaga University, Spokane, WA

- Faculty Senate - representative for School of Engineering and Applied Sciences 2017
- Faculty representative on the university-wide Climate Action Committee 2017
- Search Committee Member for Mechanical Engineering Assistant Professor 2017
- Search Committee Member for Mechanical Engineering Assistant Professor 2017
- Society of Automotive Engineers Baja Club Faculty Advisor 2015 to Present
- Search Committee Member for Mechanical Engineering Laboratory Manager 2016
- Mechanical Engineering representative on CEDE¹ Committee 2015-2016

SERVICE TO THE
PROFESSION

Peer-Reviewer:

- Reviewer for Proceedings of the Combustion Institute²
- Reviewer for the 35th International Symposium on Combustion
- Reviewer for Fuel
- Reviewer for Energy&Fuels
- Reviewer for Fuel Processing Technology
- Reviewer for Journal of Aerospace Engineering (Part D)

¹CEDE or the Center for Engineering Design & Entrepreneurship Committee is charged with managing the Senior Capstone Design/Build experience for the School of Engineering and Applied Sciences

²Awarded Elsevier "Outstanding Reviewer" award for 2016 for reviews for the Proceedings of the Combustion Institute

- Reviewer for Journal of Aerospace Engineering (Part G)
- Reviewer for the SAE 2016 World Congress and Exhibition
- Reviewer for the SAE 2014 World Congress and Exhibition
- Reviewer for SAE International Journal of Fuels & Lubricants

Session Chair, 9th U.S. National Combustion Meeting

AFFILIATIONS & MEMBERSHIPS Current Academic and Professional Memberships

- The Combustion Institute
- Society of Automotive Engineers

UNDERGRADUATE RESEARCH STUDENTS Alyssa Saad Fall 2017 to Spring 2018

- Project Title: “Micro-reactor investigation of Biogas Flames”
- Duties include experimental setup and data collection and presenting the work at the 14th Gonzaga Science Research Program (2017).

Karlene McCauley Fall 2017 to Spring 2018

- Project Title: “Micro-reactor investigation of Biogas Flames”
- Duties include experimental setup and data collection and presenting the work at the 14th Gonzaga Science Research Program (2017).

Katherine Wagner Spring 2017

- Project Title: “LED-Based Diagnostics of Biogas Flames”
- Duties include experimental setup and data collection.

Harrison Van Til Fall 2016

- Project Title: “LED-Based Diagnostics of Biogas Flames”
- Duties include experimental setup and data collection and presenting the work at the 13th Gonzaga Science Research Program (2016).

Weston Staab Summer 2016 to Spring 2017

- Project Title: “Micro-reactor investigation of Biogas Flames”
- Duties include experimental setup and data collection and presenting the work at the 13th Gonzaga Science Research Program (2016).

James Consiglio Summer 2016

- Project Title: “LED-Based Diagnostics of Biogas Flames”
- Duties included initial experimental setup and data collection and presenting the work at the 13th Gonzaga Science Research Program (2016).

COURSES
TAUGHT

Table 1: Gonzaga University

Course Number and Name	Date	Enrollment
ENSC 352 01: Fluid Mechanics	Fall 2015	47
ENSC 352 02: Fluid Mechanics	Fall 2015	29
MENG 321 03: Thermodynamics I	Fall 2015	26
MENG 322 01: Thermodynamics II	Spring 2016	40
MENG 322 02: Thermodynamics II	Spring 2016	40
ENSC 352 01: Fluid Mechanics	Spring 2016	14
MENG 321 01: Thermodynamics	Fall 2016	25
MENG 321 02: Thermodynamics	Fall 2016	34
MENG 322 01: Thermodynamics II	Spring 2017	15
MENG 322 02: Thermodynamics II	Spring 2017	32
ENSC 483 01: Independent Study	Summer 2017	1

Table 2: Colorado State University

Course Number and Name	Date	Enrollment
MECH 337: Thermodynamics ³	Fall 2013	80

Table 3: UOP, a Honeywell Company

Course Number and Name	Date	Approx. Enrollment	Location
UOP: CCR Platforming/Hydrotreating	Feb 2010	40	Quinzhou, China
UOP: CCR Platforming	Nov 2009	40	Phoenix, AZ
UOP: Fixed Bed Platforming	Oct 2009	20	Antalya, Turkey
UOP: CCR Platforming	Sept 2009	20	Des Plaines, IL
UOP: CCR Platforming	May 2009	20	Tuscaloosa, AL

³Teaching Assistant

PEER-REVIEWED
PUBLICATIONS

12. Decker, T.; **Baumgardner, M.E.**; Prapas, J.; Bradley, T.B. (2017). *A Modeling Tool for Household Biogas Burner Flame Port Design*. ASME Journal of Mechanical Design. (submitted)
11. **Baumgardner, M.E.** and Olsen, D.B. (2017) *Poison Build-up and Performance Degradation of an Oxidation Catalyst in 2-Stroke Natural Gas Engine Exhaust*. Proceedings of the ASME 2017 Internal Combustion Engine Division Fall Technical Conference. Seattle, WA, October 2017. ICEF2017-3550.
10. **Baumgardner, M.E.**, Lakshminarayanan, A.; Olsen, D.B.; Ratcliff, M.A.; McCormick, R.L.; Marchese, A.J. (2017). *Durability Testing of Biomass Based Oxygenated Fuel Components in a Compression Ignition Engine*. Proceedings of the ASME 2017 Internal Combustion Engine Division Fall Technical Conference. Seattle, WA, October 2017. ICEF2017-3551.
9. Dumitrache, C.; **Baumgardner, M.E.**; Boissiere, A.; Maria, A.; Roucis, J.; Marchese, A.J.; Yalin, A. (2017). *A study of laser induced ignition of methane-air mixtures inside a Rapid Compression Machine*. Proceedings of the Combustion Institute, 36 (3), pp 3431-3439.
doi:10.1016/j.proci.2016.05.033
8. Tryner, J.; Tillotson, J.; **Baumgardner, M.E.**; Mohr, J.; DeFoort, M.; Marchese, A. (2016) *The effects of air flow rates, secondary air inlet geometry, fuel type, and operating mode on the performance of semi-gasifier cookstoves*. Environmental Science & Technology, 50 (17), pp 97549763.
doi: 10.1021/acs.est.6b00440
7. Dumitrache, C.; **Baumgardner, M.E.**; Boissiere, A.; Marchese, A.J.; Yalin, A.; Maria, A.; Roucis, A. (2015) *Laser Ignition of Methane-Air Mixtures with a Rapid Compression Machine*. 53rd AIAA Aerospace Sciences Meeting, AIAA Science and Technology Forum 2015. Kissimme, FL, January 2015. doi.org/10.2514/6.2015-1831
6. Dumitrache, C.; Boissiere, A.; **Baumgardner, M.E.**; Marchese, A.; Yalin, A.; Maria, A.; and Roucis, J. (2015) *Laser Ignition of Methane-Air Mixtures: An Investigation of the Lean Limit and Minimum Ignition Energy*. OSA Technical Digest (online) (Optical Society of America, 2015), paper W3A.4.
doi:10.1364/LIC.2015.W3A.4
5. **Baumgardner, M.E.**, Vaughn, T.L.; Lakshminarayanan, A.; Olsen, D.; Ratcliff, M.A.; McCormick, R.L.; Marchese, A.J (2015) *Combustion of Lignocellulosic Biomass Based Oxygenated Components in a Compression Ignition Engine*. Energy&Fuels 29 (11), pp. 7317-7326.
doi:10.1021/acs.energyfuels.5b01595
4. Hockett, A.; Barta, J.; **Baumgardner, M.E.**; Hampson, G.; Marchese, A. (2014) *An experimental and Multidimensional Computational Study on Uncontrolled Combustion Rates in a Light Duty Natural Gas/Diesel Dual Fuel Engine*. Combustion Science and Technology. (submitted).
3. Prapas, J.; **Baumgardner, M.E.**; Marchese, A. J.; Willson, B.; and DeFoort, M. (2014) *Influence of Chimneys on Combustion Characteristics of Buoyantly Driven Biomass Stoves*. Energy for Sustainable Development. 23, pp. 286-293.
doi:10.1016/j.esd.2014.08.007
2. **Baumgardner, M.E.**; Sarathy, S.M.; and Marchese, A.J. (2013) *Autoignition Characterization of Primary Reference Fuels and n-Heptane/n-Butanol Mixtures in a Constant Volume Combustion Device and Homogeneous Charge Compression Ignition Engine*. Energy&Fuels. 27 (12), pp. 77787789.
doi:10.1021/ef4015982

1. Bucy, H.; **Baumgardner, M.E.**; and Marchese, A. J. (2012). *Chemical and Physical Properties of Algal Methyl Ester Biodiesel Containing Varying Levels of Methyl Eicospentaenoate and Methyl Docosaheptaenoate*. *Algal Research* 1 (1) pp. 5769. doi:10.1016/j.algal.2012.02.001

SEMINARS &
CONFERENCE
PRESENTATIONS

16. Staab, W.; Wagner, K.; **Baumgardner, M.E.** (2017) *Optical Diagnostics of Simple Biogas Flames*. Work-in-Progress Poster Session. 10th U.S. National Combustion Meeting. College Park, Maryland, April 2017.

UNDERLINE DENOTES
UNDERGRADUATE
RESEARCH STUDENT

15. **Baumgardner, M.E.**; Lakshminarayanan, A.; Olsen, D.; Ratcliff, M.A.; McCormick, R.L.; Marchese, A.J. (2017) *Durability Testing of Biomass Based Oxygenated Fuel Components in a Compression Ignition Engine*. 10th U.S. National Combustion Meeting. College Park, Maryland, April 2017.
14. Gould, C.; Bhoite, S.; **Baumgardner, M.E.**; Mohr, J.; Dumitrache, C.; Marchese, A.J. (2017) *Autoignition of Liquid Hydrocarbon Droplets in Lean, High Pressure Natural Gas Mixtures in a Rapid Compression Machine*. 10th U.S. National Combustion Meeting. College Park, Maryland, April 2017.
13. Decker, T.; **Baumgardner, M.E.**; Bradley, T.; Prapas, J. (2017) *A Modeling Tool for Household Biogas Burner Flame Port Design*. 10th U.S. National Combustion Meeting. College Park, Maryland, April 2017.
12. Staab, W.; Van Til, H.; Consiglio, J.; **Baumgardner, M.E.** (2016) *Optical Diagnostics of Simple Biogas Flames*. 13th Annual Poster Session. Gonzaga Science Research Program. Spokane, Washington, October 2016.
11. **Baumgardner, M.E.**, et al. (2016) *Assessing the Effect of Increased Levels of Biomass Based Oxygenated Components in a Diesel Engine*. Spring Technical Meeting of the Western States Section of the Combustion Institute. Seattle, Wa, March 21-22, 2016.
10. **Baumgardner, M.E.**; Gould, C.; Marchese, A.J. (2014) *Relationship between octane number, cetane number, and methane number: analysis of constant volume combustion chamber and variable compression ratio engine results*. Work-in-Progress Poster Session. 35th Symposium (International) on Combustion. San Francisco, California, August 2014.
9. Hockett, A.; Barta, J.; Polley, N.; Hampson, G.; **Baumgardner, M.E.**; Marchese, A.J. (2014) *Experiments and Computational Modeling of Natural Gas/Diesel Dual Fuel Combustion with Exploration of Uncontrolled Combustion Rates*. Work-in-Progress Poster Session. 35th Symposium (International) on Combustion. San Francisco, California, August 2014.
8. **Baumgardner, M.E.**; Llanos, J.D.; Marchese, A. J. (2013). *A Phenomenological Relationship between Octane Number and Cetane Number and the Impact on HCCI Fuel Characterization*. Fall Technical Meeting of the Western States Section of the Combustion Institute. Fort Collins CO, October 7-8, 2013.
7. Thompson, A.; **Baumgardner, M.E.**; and Marchese, A. J. (2013). *Modeling In-Cylinder Heat Transfer for a Single Cylinder HCCI Engine*. Fall Technical Meeting of the Western States Section of the Combustion Institute. Fort Collins CO, October 7-8, 2013.
6. **Baumgardner, M.E.**; Marchese, A. J.; and Sarathy, M. (2013). *Autoignition Characterization of Primary Reference Fuels and n-Heptane/n-Butanol mixtures in a Constant Volume Combustion Device and Homogeneous Charge Compression Ignition Engine*. The 8th US National Meeting of the Combustion Institute. Park City, UT, May 19-22, 2013.

5. **Baumgardner, M.E.**; Hockett, A.; and Marchese, A. J. (2012). *Targeted chemical mechanism modification and experimental validation for bio-alcohol/FAME blends for use in traditional and advanced combustion applications*. 1st Annual RCM Workshop. Argonne National Laboratory, November 2012.
4. **Baumgardner, M.E.**; Hockett, A.; and Marchese, A. J. (2012). *Targeted chemical mechanism modification and experimental validation for bio-alcohol/FAME blends for use in traditional and advanced combustion applications*. Work-in-Progress Poster Session. 34th Symposium (International) on Combustion. Warsaw, Poland, August 2012.
3. **Baumgardner, M.E.** and Marchese, A. J. (2012). Work-in-Progress Poster Session. Semi-annual C2B2 Meeting. Boulder, CO, March 2012.
2. **Baumgardner, M.E.** and Marchese, A. J. (2011). Work-in-Progress Poster Session. Semi-annual C2B2 Meeting. Fort Collins, CO, August 2011.
1. **Baumgardner, M.E.**; Otwell, D; Basu-Dutt, S. (2003) Computational Electrochemistry, Southeastern Regional Meetings of the American Chemical Society, Atlanta, GA, November 2003