

CASEY M. ALLEN

Marquette University, Department of Mechanical Engineering
casey.allen@marquette.edu – 414-288-2160 – 1637 W. Wisconsin Ave, Milwaukee, WI 53233

RESEARCH INTERESTS

Low-Temperature Autoignition: *Experimental characterization of important chemical pathways for autoignition models*
Alternative Fuels: *Evaluation of new synthetic and bio-based fuels as replacements for conventional distillate fuels*
Global Uncertainty Analysis: *Global methods for designing experiments and interpreting experimental data*
Advanced Engine Chemistry: *Integration of chemical kinetic data with advanced engine designs and multi-step models*

ACADEMIC CREDENTIALS

- 2012** **MICHIGAN STATE UNIVERSITY** – East Lansing, MI
PH.D., Mechanical Engineering
Dissertation: Advanced Rapid Compression Machine Test Methods and Surrogate Fuel Modeling for Bio-Derived Jet and Diesel Fuel Autoignition
Advisor: Dr. Tonghun Lee
- 2004** **UNIVERSITY OF IOWA** – Iowa City, IA
B.S.E., Chemical Engineering
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PROFESSIONAL EXPERIENCE

- 2012 – Present** **Marquette University, Assistant Professor** **Milwaukee, WI**
- Established the *Low-Temperature Combustion & Engines Lab*, aimed at experimentally characterizing the important chemical pathways during premixed and spray ignition.
 - Supervising graduate student on an experimental study of heat loss effects during low-temperature autoignition in a rapid compression expansion machine (RCEM).
 - Developed and taught undergraduate and graduate courses in the thermal-fluids area, including thermodynamics, fundamental combustion, and internal combustion engines.
- 2012** **Michigan State University, Postdoctoral Researcher** **East Lansing, MI**
- Preparation and development of research proposals in the fields of renewable energy and combustion.
 - Development of a kinetic spectrometer for measurements of spectrally-resolved chemiluminescence during low-temperature autoignition.
 - Exploration of a high-speed two-color pyrometry system for quantifying the chemical soot-reducing potential of oxygenate additives.
- 2007 – 2012** **Michigan State University, Graduate Research Assistant** **East Lansing, MI**
- Worked as a Ph.D. student in the *Laser Diagnostics Lab for Advanced Energy and Propulsion Research*
 - Designed and built first-known aerosol rapid compression machine (RCM) for combustion characterization of non-volatile fuels
 - Pioneered development of a novel approach for preparing reactive gas phase premixtures directly in an RCM, enabling fundamental ignition delay measurements of non-volatile fuels ($p_{sat} < 10^{-3}$ Torr @ 298 K, e.g. cetane)
 - Investigated gas-phase autoignition behavior of bio-based synthetic jet fuels and conventional jet fuel (JP-8)
 - Designed surrogate fuels for predicting global ignition behavior of bio-synthetic hydrotreated renewable jet fuels
 - Characterized spray ignition behavior of canola and soy-based fatty acid esters relative to diesel fuel
- 2004 – 2007** **Accenture LLC, Business & Technology Consultant** **Chicago, IL**
- Managed team of consultants and client resources to ensure on-time application delivery
 - Developed and maintained work plan across multiple application teams
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AWARDS & HONORS (SINCE 2008)

- 2012 Michael J. Wallace Endowed Scholarship
2011 Dissertation Completion Fellowship
2009 Colucci Graduate Fellowship for Achievement in Energy Research
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TEACHING ACTIVITIES

INSTRUCTIONAL EXPERIENCE

Fall 2012	Thermodynamics I	<i>Enrollment: 30</i>
Spring 2013	Internal Combustion Engines (MEEN 4310)	<i>Enrollment: 16</i>
Fall 2013	Thermodynamics II (MEEN 3340) (2 sections)	<i>Enrollment: 36 / 31</i>
Spring 2014	Combustion: Thermochemistry, Kinetics & Applications (MEEN 4310)	<i>Enrollment: 20</i>
Spring 2014	Advanced Topics in Combustion Kinetics (MEEN 6931)	<i>Enrollment: 4</i>

CURRICULUM DEVELOPMENT

MEEN 4310: Combustion: Thermochemistry, Kinetics & Applications

Developed an undergraduate/graduate level course on introductory combustion topics. Content includes first-law and second-law analysis of reacting systems, chemical kinetics and mechanism analysis for combustion, integration of chemical mechanisms with physical reactor models, and the application of these topics to engine modeling.

MEEN 6931: Advanced Topics in Combustion Kinetics

Developed a graduate level course relevant to the study of chemical kinetics and sensitivity/uncertainty analysis of kinetic mechanisms. Content includes theoretical techniques for calculating elementary reaction rate coefficients and their pressure dependencies (transition state theory, Lindemann theory, Hinshelwood theory, QRRK theory for unimolecular and bimolecular chemical activation reactions) and global uncertainty/sensitivity analysis techniques for factor fixing and factor prioritization in kinetic models.

GRADUATE STUDENT SUPERVISION

John Neuman	Master's (Thesis)	Exp. Graduation: 5/2015
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GRADUATE COMMITTEE MEMBER

Allison Chouinard	Master's (Thesis)	Exp. Graduation: 5/2014
Merit Schumaker	Master's (Thesis)	Exp. Graduation: 5/2015
Jeff Lajeunesse	Master's (Thesis)	Exp. Graduation: 5/2015

RESEARCH ACTIVITIES

PUBLICATIONS: FULL ARTICLES IN REFEREED JOURNALS

- 10 **Autoignition Behavior of Synthetic Alternative Jet Fuels: An Examination of Chemical Composition Effects on Ignition Delays at Low to Intermediate Temperatures**
Proceedings of the Combustion Institute (Accepted)
D. Valco, G. Gentz, C. Allen, M. Colket, T. Edwards, S. Gowdagiri, M. Oehlschlaeger, E. Toulson, T. Lee
- 9 **Autoignition Characteristics of JP-5 and HRJ-5 using Conventional Jet Fuel Surrogates**
Energy & Fuels, Vol. 27, pp. 7790-7799 (2013)
C. Allen, D. Valco, E. Toulson, J.H. Yoo, T. Lee
- 8 **Characterization of the Effect of Fatty Ester Composition on the Ignition Behavior of Biodiesel Fuel Sprays**
Fuel, Vol. 111, pp. 659-669 (2013)
C. Allen, E. Toulson, D. Tepe, H. Schock, D. Miller, T. Lee
- 7 **Ignition Behavior and Surrogate Modeling of JP-8 and of Camelina and Tallow Hydrotreated Renewable Jet Fuels at Low Temperatures**
Combustion and Flame, Vol. 160, pp. 232-239 (2013)
C. Allen, D. Valco, E. Toulson, T. Edwards, T. Lee

- 6 **Application of a Novel Charge Preparation Approach to Testing the Autoignition Characteristics of JP-8 and Camelina Hydroprocessed Renewable Jet Fuel**
Combustion and Flame, Vol. 159, pp. 2780-2788 (2012)
C. Allen, E. Toulson, T. Edwards, T. Lee
- 5 **Ignition Characteristics of Diesel and Canola Biodiesel Sprays in the Low-Temperature Combustion Regime**
Energy & Fuels, Vol. 25, pp. 2896-2908 (2011)
C. Allen, E. Toulson, D. Hung, H. Schock, D. Miller, T. Lee
- 4 **Modeling the Autoignition of Fuel Blends with a Multi-step Model**
Energy & Fuels, Vol. 25, pp. 632-639 (2011)
E. Toulson, C. Allen, D. Miller, J. McFarlane, H. Schock, T. Lee
- 3 **An Aerosol Rapid Compression Machine for Studying Energetic-Nanoparticle-Enhanced Combustion of Liquid Fuels**
Proceedings of the Combustion Institute, Vol. 33, pp. 3367-3374 (2010)
C. Allen, G. Mittal, C.-J. Sung, E. Toulson, T. Lee
- 2 **Optimization of a Multi-step Model for the Auto-Ignition of Dimethyl Ether in a Rapid Compression Machine**
Energy & Fuels, Vol. 24, pp. 3510-3516 (2010)
E. Toulson, C. Allen, D. Miller, H. Schock, T. Lee
- 1 **Modeling the Auto-Ignition of Oxygenated Fuels using a Multi-step Model**
Energy & Fuels, Vol. 24, pp. 888-896 (2010)
E. Toulson, C. Allen, D. Miller, T. Lee

PUBLICATIONS: NON-REFEREED CONFERENCE PROCEEDINGS

- 6 **The Influence of Non-Uniform Initial Conditions on Temperature Field Development in Rapid Compression Machine Experiments**
52nd AIAA Aerospace Sciences Meeting & Exhibit (as part of SciTech 2014), 1/13/14
J. Neuman, C. Allen
- 5 **Autoignition Behavior of Petroleum-Based and Hydroprocessed Renewable Jet Fuel Blends in a Rapid Compression Machine**
51st AIAA Aerospace Sciences Meeting & Exhibit, 1/7/13
D. Valco, C. Allen, E. Toulson, T. Lee
- 4 **Optical Diagnostic Comparisons of Pump Diesel with Bio-derived Diesel Blends**
SAE 2012 World Congress, 4/24/11
C. Squibb, H. Schock, C. Allen, T. Lee, M. Poort, K. Crayne
- 3 **An Experimental Investigation of the Autoignition Characteristics of Camelina-Based Hydroprocessed Renewable Jet Fuel**
49th AIAA Aerospace Sciences Meeting & Exhibit, 1/6/11
C. Allen, E. Toulson, T. Lee
- 2 **Energetic-Nanoparticle-Enhanced JP-8 Combustion in an Aerosol Rapid Compression Machine**
6th U.S. National Combustion Meeting, 5/20/09
C. Allen, T. Lee
- 1 **Energetically-Enhanced Combustion of Liquid Fuels in a Rapid Compression Machine**
47th AIAA Aerospace Sciences Meeting & Exhibit, 1/5/09
C. Allen, T. Lee

POSTERS

- 1 **Direct Test Chamber (DTC) Charge Preparation Method**
1st International RCM Workshop, Argonne National Laboratory, Chicago, Illinois, 9/28/12 – 9/29/12
C. Allen, D. Valco, E. Toulson, T. Edwards, T. Lee

FUNDED RESEARCH GRANTS

- 2014 **Gas-Chromatography-Mass Spectrometry for Energy Research**
Marquette University, College of Engineering
Budget: \$92,000
- 2013 **High-Fidelity *iso*-Octane Ignition Kinetics – New Rigor for an Unresolved Problem**
American Chemical Society, Petroleum Research Fund
Budget: \$100,000
Project Timeline: 8/2013 – 7/2015
- 2012 **Optical Diagnostics for Combustion Characterization of Compression Autoignition Engines**
Michael J. Wallace Endowment
Budget: \$10,000/year
Project Timeline: Renewable until 2018
- 2012 **A Computationally-Efficient Droplet Evaporation Model for Multi-Component Bio-Based Fuel Blends**
Marquette University
Budget: \$10,150
Project Timeline: 5/2013 – 12/2013