

Fujia Wu

Department of Mechanical & Aerospace Engineering
D103 Engineering Quad, Olden Street
Princeton, NJ 08544

Office: (609) 258-5178 Cell: (609) 865-9961
fujiawu@princeton.edu, wufujia@gmail.com
www.fujiawu.com

Education

- Ph.D. expected 2014** **Princeton University, Princeton, NJ**
Mechanical & Aerospace Engineering
• Advisor: Prof. Chung K. Law
• Thesis Topic: “Dynamics, Instabilities and Chemistry of Laminar and Turbulent Flames”
- M.A. 2010** **Princeton University, Princeton, NJ**
Mechanical & Aerospace Engineering
- M.E. 2008** **Tsinghua University, Beijing, China**
Engineering Thermophysics
• Thesis: “Using Biodiesel Based Oxygenated Blend Fuels for Reducing Emissions from Diesel Engines”
- B.E. 2006** **Tsinghua University, Beijing, China**
Vehicle Engineering

Honors and Awards

- **Bernard Lewis Fellowship**, The Combustion Institute, 2014 (to encourage high quality research in combustion by young scientists and engineers, awarded to no more than five recipients in the world every two years)
- **Runner-up for the Best Presentation**, “Ignition, Propagation and Acceleration of Expanding Flames”, MAE Annual Research Day Prize, Princeton University, September 13, 2013
- **First Place Award**, “Three Faces of An Expanding Flame”, Technical Merit of the Combustion Art Competition, 8th U.S. National Combustion Meeting, Park City, Utah, May 19-22, 2013
- **Best Presentation Award**, “New Fundamental Understandings of Flame Chemistry and Dynamics from Experimentation on Expanding Flames”, First International Education Forum on Environment and Energy Science, Hawaii, December 14-18, 2012
- **George H. Markstein Best Paper Award**, “Laminar Flame Speeds of Cyclohexane and Mono-alkylated Cyclohexanes at Elevated Pressures”, Technical Meeting of the Eastern States Section of the Combustion Institute, University of Connecticut, Storrs, Connecticut, October 9-12, 2011
- **Cummins Merit Fellowship**, Princeton University, 2008
- **Excellent Undergraduate Award**, Tsinghua University, 2004, 2005

Publications

Peer-Reviewed Journal Articles

1. Fujia Wu, Abhishek Saha, Swetaprovo Chaudhuri, and Chung K. Law. Facilitated ignition in turbulence through differential diffusion. *Physical Review Letters*, 2014; 113: 024503
2. Fujia Wu, Wenkai Liang, Zheng Chen, Yiguang Ju, and Chung K. Law. Uncertainty in stretch extrapolation of laminar flame speed from expanding spherical flames. *Proceedings of the Combustion Institute*, in press
3. Fujia Wu, Abhishek Saha, Swetaprovo Chaudhuri, and Chung K. Law. Propagation speeds of expanding turbulent flames of C_4 to C_8 *n*-alkanes at elevated pressures: experimental determination, fuel similarity, and stretch-affected local extinction. *Proceedings of the Combustion Institute*, in press
4. Xiaoyu Li, Xiaoqing You, Fujia Wu, and Chung K. Law. Uncertainty analysis of the kinetic model prediction for high-pressure H_2/CO combustion. *Proceedings of the Combustion Institute*, in press
5. Swetaprovo Chaudhuri, Fujia Wu, and Chung K. Law. Turbulent flame speed scaling for expanding flames with Markstein diffusion considerations. *Physical Review E*, 2013; 88: 033005
6. Fujia Wu and Chung K. Law. An experimental and mechanistic study on the laminar flame speed, Markstein length and flame chemistry of the butanol isomers. *Combustion and Flame*, 2013; 160: 2744-2756
7. Fujia Wu, Grunde Jomaas, and Chung K. Law. An experimental investigation on self-acceleration of cellular spherical flames. *Proceedings of the Combustion Institute*, 2013; 34: 937-945
8. Fujia Wu, Andrew P. Kelley, and Chung K. Law. Laminar flame speeds of cyclohexane and mono-alkylated cyclohexanes at elevated pressures. *Combustion and Flame*, 2012; 159: 1417-1425
9. Swetaprovo Chaudhuri, Fujia Wu, Delin Zhu, and Chung K. Law. Flame speed and self-similar propagation of expanding turbulent premixed flames. *Physical Review Letters*, 2012; 108: 044503
10. Fujia Wu, Andrew P. Kelley, Chenglong Tang, Delin Zhu, and Chung K. Law. Measurement and correlation of laminar flame speeds of CO and C_2 hydrocarbons with hydrogen addition at atmospheric and elevated pressures. *International Journal of Hydrogen Energy* 2011; 36 (20): 13171-13180
11. Jianxin Wang, Fujia Wu, Jianhua Xiao, and Shijin Shuai. Oxygenated blend design and its effects on reducing diesel particulate emissions. *Fuel* 2009; 88: 2037-2045
12. Fujia Wu, Jianxin Wang, Wenmiao Chen, and Shijin Shuai. A study on emission performance of a diesel engine fueled with five typical methyl ester biodiesels. *Atmospheric Environment* 2009; 43 (7): 1481-1485
13. Xu He, Xiao Ma, Fujia Wu, and Jianxin Wang. Visualization investigation of soot characteristics of engine fuelled with biodiesel fuel. *Chinese Internal Combustion Engine Engineering* 2009; 30(2): 1-5
14. Xu He, Xiao Ma, Fujia Wu, and Jianxin Wang. Investigation on the soot formation of biodiesel fuel by laser diagnostics. *Chinese Internal Combustion Engine Engineering* 2009; 30(1): 1-5
15. Wenmiao Chen, Fujia Wu, Jianxin Wang, and Shijin Shuai. Effect of cetane number on combustion and emission of a Euro-IV diesel engine. *Chinese Internal Combustion Engine Engineering* 2008; 29(6): 1-5

Conference Publications

1. Fujia Wu, Abhishek Saha, Swetaprovo Chaudhuri, and Chung K. Law. An investigation on fuel similarity of turbulent flames for C_4 - C_8 *n*-Alkanes. *Technical Meeting of the Eastern States Section of the Combustion Institute*, Clemson University, South Carolina, October 13-16, 2013
2. Fujia Wu, Wenkai Liang, Chung K. Law, and Zheng Chen. On the uncertainty of extrapolation of laminar flame speed and Markstein length from expanding spherical flames. *Technical Meeting of the*

Eastern States Section of the Combustion Institute, Clemson University, South Carolina, October 13-16, 2013

3. Fujia Wu and Chung K. Law. Laminar flame speed, Markstein length and flame chemistry of the butanol isomers from 1 atm to 5 atm. *8th US National Combustion Meeting*, Park City, Utah, May 19-22, 2013
4. Fujia Wu, Grunde Jomaas, and Chung K. Law. On self-acceleration of cellular spherical flames. *Technical Meeting of the Eastern States Section of the Combustion Institute*, University of Connecticut, Storrs, Connecticut, October 9-12, 2011
5. Fujia Wu, Andrew Kelley, and Chung K. Law. Laminar flame speeds of cyclohexane and mono-alkylated cyclohexanes at elevated pressures. *Technical Meeting of the Eastern States Section of the Combustion Institute*, University of Connecticut, Storrs, Connecticut, October 9-12, 2011 (George H. Markstein Best Paper Award)
6. Fujia Wu, John Bechtold, and Chung K. Law. Effects of variable thermodynamic and transport properties on Markstein number and flame front stability. *Technical Meeting of the Eastern States Section of the Combustion Institute*, University of Connecticut, Storrs, Connecticut, October 9-12, 2011
7. Swetaprovo Chaudhuri, Fujia Wu, Delin Zhu, and Chung K. Law. Turbulent flame speeds and self similarity of expanding premixed flames. *Technical Meeting of the Eastern States Section of the Combustion Institute*, University of Connecticut, Storrs, Connecticut, October 9-12, 2011
8. Fujia Wu, Andrew P. Kelley, Delin Zhu, and Chung K. Law. Further study on effects of hydrogen addition on laminar flame speeds of fuel-air mixtures. *7th US National Combustion Meeting*, Atlanta, Georgia, March 20-23, 2011
9. Fujia Wu, Jianxin Wang, Wenmiao Chen, and Shijin Shuai. Effects of different biodiesels and their blends with oxygenated additives on emissions from a diesel engine. SAE Technical Paper 2008-01-1812, *Society of Automotive Engineers Fuels and Lubricants Congress*, Shanghai, China, June 23-26, 2008
10. Xu He, Xiao Ma, Fujia Wu, Jianxin Wang, and Shijin Shuai. Investigation of soot formation in laminar diesel diffusion flame by two-color laser induced incandescence. SAE Technical Paper 2008-01-1064, *Society of Automotive Engineers World Congress*, Detroit, USA, April 14-17, 2008
11. Wenmiao Chen, Jianxin Wang, Shijin Shuai, and Fujia Wu. Effects of fuel quality on a Euro IV diesel engine with SCR after-treatment. SAE Technical Paper 2008-01-0638, *Society of Automotive Engineers World Congress*, Detroit, USA, April 14-17, 2008
12. Wenmiao Chen, Fujia Wu, Jianxin Wang, and Shijin Shuai. Effects of diesel fuel quality on engine emission characteristics. *Chinese Automotive Powertrain Conference*, Tianjin, China, September 6-9, 2007
13. Wenmiao Chen, Jianxin Wang, Shijin Shuai, and Fujia Wu. Effect of sulfur in diesel fuel on engine performance. *First Meeting of Oil Product and Clean Fuels Branch of Chinese Society for Internal Combustion Engines*, Beijing, China, May 20-21, 2007

Conference Presentations

1. Fujia Wu, Abhishek Saha, Swetaprovo Chaudhuri, Sheng Yang, and Chung K. Law. Similarity and scaling of turbulent flame speeds for expanding premixed flames of C_4 - C_8 *n*-alkanes. *66th Annual Meeting of the APS Division of Fluid Dynamics*, Pittsburgh, Pennsylvania, November 24-26, 2013
2. Fujia Wu and Chung K. Law. Three faces of an expanding flame. *Princeton Research Symposium*, Princeton, NJ, October 20, 2013
3. Fujia Wu and Chung K. Law. Ignition, Propagation and Acceleration of Expanding Flames, *Princeton University MAE Annual Research Day*, Princeton, New Jersey, September 13, 2013 (Runner-up for the Best Presentation)

4. Fujia Wu and Chung K. Law. New fundamental understandings of flame chemistry and dynamics from experimentation on expanding premixed flames. *The First International Education Forum on Environment and Energy Science*, Hawaii, December 14-18, 2012 (Best Presentation Award)
5. Swetaprovo Chaudhuri, Fujia Wu and Chung K. Law. Turbulent flame speed scaling for positive Markstein number expanding flames in near isotropic turbulence. *65th Annual Meeting of the APS Division of Fluid Dynamics*, San Diego, California, November 18-20, 2012
6. Swetaprovo Chaudhuri, Fujia Wu, Delin Zhu and Chung K. Law. Turbulent flame speed and self similarity of expanding premixed flames. *64th Annual Meeting of the APS Division of Fluid Dynamics*, Baltimore, Maryland, November 20-22, 2011
7. Xu He, Xiao Ma, Fujia Wu, and Jianxin Wang. Investigation of soot formation in the oxygenated fuels flame by laser induced fluorescence and incandescence. *7th International Conference on Modeling and Diagnostics for Advanced Engine Systems*, Sapporo, Japan, June 28-31, 2008

Patents

1. Jianxin Wang, Fujia Wu, Jianhua Xiao, and Shijin Shuai. Oxygen-containing blended fuel for reducing small particle emission of diesel car. Publication No. CN 101338227, Published in People's Republic of China on January 7, 2009 (in Chinese)

Research Experience

Department of Mechanical & Aerospace Engineering, Princeton University, Princeton, NJ

Research Assistant, Prof. Chung K. Law's research group, 2008-present

Research Topics: dynamics, instabilities and chemistry of laminar and turbulent flames

- Developed a unique dual-chamber, high-pressure, fan-stirred, preheated combustion vessel for studying both laminar and turbulent flames with well-defined initial and boundary conditions.
- Developed time-resolved high-speed Schlieren imaging and particle image velocimetry (PIV) system.
- Acquired high-pressure laminar flame speed data for various fuels, including hydrogen, carbon monoxide, C₁-C₈ n-alkanes, C₆-C₈ cyclo-alkanes, butanols, dimethyl ether (DME), toluene and xylenes, and quantified the experimental uncertainty.
- Explained the fundamental reason why cyclohexane has higher flame speeds than mono-alkylated cyclohexanes, and why the general rule that branching of fuel molecule lowers flame speed for hydrocarbons can also be applied to alcohols.
- Discovered that unstable flames due to hydrodynamic instability always undergo strong acceleration, with propagation speed being non-integer powers of flame radius, suggesting fractal geometry.
- Discovered that for normal conditions turbulent flame speed scales well with a Reynolds number defined based on the properties of the laminar flamelet; however, for lean burning of heavy hydrocarbon fuels, stretch-induced local extinction destroys this scaling.
- Discovered that turbulence can facilitate spark ignition when the thermal diffusivity sufficiently exceeds the mass diffusivity of the deficient species.

State Key Laboratory of Automotive Safety and Energy, Tsinghua University, Beijing, China

Research Assistant for Prof. Jianxin Wang, 2005-2008

Research Topics: pollutant emissions from internal combustion engines, performance of oxygenated biofuels on real engines

- Developed a method for sampling and separating engine-emitted particulate matter into soot, sulfate and organic fraction.

- Evaluated the engine performance of five typical biodiesels made from different source materials.
- Based on oxygen content and autoignition tendency, designed a novel fuel blend using regular diesel, biodiesel and ethanol (or dimethyl carbonate), which could reduce engine-emitted particulate by 80%.
- Both NO_x and soot emissions were reduced simultaneously and Euro IV test was passed without any after-treatment device.

Teaching Experience

- **Teaching Assistant for “MAE305-MAT301, Mathematics in Engineering”**

Fall 2011, Princeton University

Instructor: Prof. Howard A. Stone

Responsibilities: Gave weekly precept lectures, designed and graded homework and exams

- **Teaching Assistant for “MAE322, Mechanical Design”**

Spring 2011, Princeton University

Instructor: Prof. Daniel M. Nosenchuck

Responsibilities: Guided course projects in machine shop, graded project demonstration and reports

- **Teaching Assistant for “MAE423, Heat Transfer”**

Fall 2010, Princeton University

Instructor: Prof. Frederick L. Dryer

Responsibilities: Gave weekly precept lectures and classroom lecture on “Numerical Methods”, graded homework and midterm exam

Skills & Expertise

- Knowledge: Mathematical Methods in Engineering, Combustion, Fluid Mechanics, Thermodynamics, Heat Transfer, Chemical Kinetics, Kinetic Theory, Computation Fluid Dynamics, Parallel Computing, Algorithms and Data Structure
- Experimental Skills: Optical and Laser Diagnostics, Spectroscopy, Engine Test, Gas Chromatography
- Computation & Programming Skills: Matlab, Mathematica, Fortran, C/C++, Java, Linux Shell, Python

Professional Affiliations

- Member, the Combustion Institute
- Member, the American Society of Mechanical Engineers (ASME)
- Member, the American Institute of Aeronautics and Astronautics (AIAA)
- Member, the American Physical Society (APS)