

BRET COLIN WINDOM

Assistant Professor
Colorado State University
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EDUCATION

University of Florida, Gainesville, FL 32611

Ph.D., Mechanical Engineering, August 8, 2009

Dissertation title: Optical diagnostic techniques in tribological analysis: applications to wear film characterization, solid lubricant chemical transition, and electrical sliding contacts.

University of Florida, Gainesville, FL 32611

M.S., Mechanical Engineering, August 2006

Thesis title: Implementation of aerodynamic focusing and a dual-pulse configuration to improve laser-induced breakdown spectroscopy aerosol particle sampling rates and analyte response.

University of Florida, Gainesville, FL 32611

B.S., Mechanical Engineering, December 2004

Cum Laude

WORK EXPERIENCE

I. Assistant Professor

(August 2016 - Present)

Colorado State University, Fort Collins, Co

II. Assistant Professor

(August 2013 – August 2016)

University of Colorado Colorado Springs, Colorado Springs, Co

III. Combustion Energy Frontier Research Center Postdoctoral Fellowship (May 2011 – July 2013)

University of Southern California, Los Angeles, CA

Supervisor: Prof. Fokion Egolfopoulos, 213.740.0480

Princeton University, Princeton, NJ

Supervisor: Prof. Yiguang Ju, 609.258.5644

Worked on multiple research projects investigating and advancing the characterization of flames and reacting flows under conditions relevant to real world applications

- Assisted in the completion of a spherically expanding flame combustion system (USC)
- Experimentally measured flame propagation of syngas fuels at elevated pressures (USC)
- Designed and implemented new PIV diagnostic technique to further investigate flame propagation of spherically expanding flames (USC)
- Used combustion simulations and reaction modeling to aid in the design of experiments
- Investigated turbulent flames to understand the coupling between complex fluid dynamics and low temperature combustion regimes (Princeton)
- Implemented laser absorption diagnostics for *in situ* characterization of plasma assisted combustion (Princeton)

IV. National Academy of Sciences Postdoctoral Associate

(July 2009 - May 2011)

The National Institute of Standards and Technology (NIST), Boulder, CO

Supervisor: Dr. Thomas J. Bruno, 303.497.5158

Worked on multiple research projects investigating and advancing volatility measurements of renewable and petroleum based hydrocarbon fuels

- Designed a new apparatus and method to precisely measure fluid volatilities at reduced pressure
- Analyzed temperature degradation effects of crude oils and biodiesel fuels with new reduced pressure advanced distillation apparatus coupled with GC-MS.
- Analyzed the vapor liquid equilibrium variability of rocket propellants.
- Applied the Advanced Distillation Curve method to analyze the volatility and composition of various hydrocarbon fuels to aid equation of state modeling and surrogate formulations.
- Performed quantitative chromatographic analysis on hydrocarbon mixtures to track the changing energy content of mixture during a distillation.

V. Graduate Student Research (January 2005 – July 2009)

Department of Mechanical Engineering

University of Florida, Gainesville, FL

Supervisor: Prof. David W. Hahn, 352.392.0807

Worked on multiple research projects in which optical techniques were implemented to study fundamental problems ranging from plasma-particle interactions to micro-scale wear and tribological phenomena

- Studied the effect of a dual laser pulse configuration on the laser-induced breakdown spectroscopic analysis of gaseous and aerosol analyte systems.
- Designed and constructed a micro-Raman/tribometer system for the *in situ* characterization of initial wear films.
- Used Raman spectroscopy to investigate plasticization of polymers during tribological tests.
- Worked together with tribologists on a multi-disciplinary project to understand wear phenomena of sliding electrical contacts by use of atomic emission spectroscopy techniques.
- Applied Raman spectroscopy toward understanding the chemical transformation/oxidation of molybdenum disulfide as it applies to solid film lubrication.
- Investigated matrix related error and plasma-analyte interactions in laser induced breakdown spectroscopy of metals in solid and aerosol forms.

TEACHING EXPERIENCE

Classes taught:

- Thermodynamics (x4)
- Propulsion
- Heat and Mass Transfer
- Combustion (graduate) (x3)

Students Advised:

- Master's students: Colin Curtis (UCCS, graduated), Stephen Burke (CSU, Summer 2017), Mangesh Dake (CSU, Spring 2018), Bahar Abdollahipoor (CSU, Spring 2018)
- PhD student: Radi Alsulami (CSU, Spring 2019)
- Funded Undergraduate Students: Brandon Patz (UCCS), Rose Szczur (UCCS), Jeffery Baston (UCCS), Stephen Burke (UCCS), Robert Rhoads (UCCS/NREL), Irene Delgado (UCCS), Diego Bestel (UCCS), Carson Belknap (CSU).

SUCCESSFUL GRANTS AND FUNDING

1. CSU Energy Institute - Undergraduate research discovery and mentoring internship, "Development of a Spray Burner to Study the Impact of Preferential Evaporation on Turbulent Flame Dynamics", 12/15/2016, Requested: \$7,000, Awarded: \$3,650.

2. National Science Foundation - Extreme Science and Engineering Discovery Environment (XSEDE), "Computational theoretical, multiscale, and phenomenological modeling of solid & fluid mechanics in extreme environments", October 15, 2016, Co-PI, Requested: 1,500,000 CPU hours, Awarded: 704,691 CPU hours, value of \$24,562.95.
3. Honda R&D Americas, "Onboard Refueling Vapor Recovery System Testbed and Simulation", October 28, 2016, PI, Requested: \$309,985, Awarded: \$309,985.
4. U.S. Department of Defense, "High Power Optical Diagnostics for Large Hydrocarbon Fuel Combustion and Flame Research", June 1, 2016, PI, Requested: \$362,384, Awarded: \$362,384.
5. Department of Energy/National Renewable Energy Laboratory – Visiting Faculty Program (VFP), "Optimized fuel composition and operating parameters for ethanol-gasoline direct injection spark ignition engines", Summer 2016, PI, Requested: \$25,000, Awarded: \$25,000.
6. UCCS Associate Vice Chancellor for Research and Faculty Development (AVCRFD) - Committee on Research and Creative Works (CRCW), "Optimized fuel composition and operating parameters for ethanol-gasoline direct injection spark ignition engines", March 6, 2016, PI, Requested: \$7,500, Awarded: \$7,500.
7. National Science Foundation - Extreme Science and Engineering Discovery Environment (XSEDE), "Methodology and Phenomenological Simulation Considerations for Multi-Application Gas Kinetic Modeling", October 15, 2015, Co-PI, Requested: 2,000,000 CPU hours, Awarded: 377,378 CPU hours, value of \$24,000.
8. UCCS Undergraduate Research Academy (URA), "Flame Extinction Behavior of Alternative Fuels", April 25, 2015, PI, Requested: \$7,000, Awarded: \$7,000.
9. UCCS Associate Vice Chancellor for Research and Faculty Development (AVCRFD) - Committee on Research and Creative Works (CRCW), "Derived Measurement of the Enthalpy of Vaporization for Complex Fuels Using a Reduced Pressure Distillation Curve Approach", March 31, 2014, PI, Requested: \$7,500, Awarded: \$7,500.
10. UCCS Undergraduate Research Academy (URA), "Volatility Characteristics of Alternative Fuels with Application to Novel Internal Combustion Engines", April 25, 2014, PI, Requested: \$7,000, Awarded: \$6,000.
11. UCCS - EAS Undergraduate Research Scholars Program, "Detailed characterization of turbulent flame planar laser induced fluorescence images", April 25, 2014, PI, Requested: \$3,000, Awarded: \$1,500.
12. NASA – Colorado Space Grant Consortium, "Colorado Space Grant - COURSE Supplement", Awarded: 9/16/2014, PI, Requested: \$5,250, Awarded: \$5,250.
13. National Science Foundation - Extreme Science and Engineering Discovery Environment (XSEDE), "Methodology and Phenomenological Simulation Considerations for Multi-Application Gas Kinetic Modeling", Awarded 10/14/14, Co-PI, Requested 1,500,000 hrs of high performance computational time, Awarded 734,060 hrs valued at \$25,417.15.
14. U.S. Department of Commerce – National Institute of Standards and Technology, "Professional Research Experience Program: Undergraduate/Graduate Student and Post-doctoral Research Fellowships at the National Institute of Standards and Technology", December 13, 2013, PI, Requested: \$5,567,501 (over 5 years), Awarded: \$5,567,501 (over 5 years).

PEER REVIEWED JOURNAL ARTICLES

1. Burke, S., Rhoads, R., McCormick, R., Ratcliff, M., **Windom, B.C.**, "*Distillation-based Droplet Modeling of Non-Ideal Oxygenated Gasoline Blends: Investigating the Role of Droplet Evaporation on PM Emissions*", SAE Int. J. Fuels Lubr. 10(1), **2017**.

2. **Windom, B.C.**, Won, S.H., Jiang, B., Ju, Y., Hammack, S., Ombrello, T., Carter, C., “Study of ignition chemistry on turbulent premixed flames of n-heptane/air by using a reactor assisted turbulent slot burner”, *Combustion and Flame*, **2016**, *169*, 19-29.
3. Lefkovitz, J., Uddi, M., **Windom, B.C.**, Lou, G., Ju, Y., “*In situ* species diagnostics and kinetic study of plasma activated ethylene pyrolysis and oxidation in a low temperature flow reactor”, *Proceedings of Combustion Institute*, **2015**, *35(3)*, 3505-3512.
4. Won, S.H., **Windom, B.C.**, Jiang, B., Ju, Y., “The role of low temperature fuel chemistry on turbulent flame propagation” *Combustion and Flame*, **2014**, *161(2)*, 475-483.
5. Shukla, B., Gururajan, V., Eisazadeh-Far, K., **Windom, B.C.**, Egolfopoulos, F.N., “Effects of electrode geometry on transient plasma induced ignition” *Journal of Physics D: Applied Physics*, **2013**, *4*, 205201.
6. **Windom, B.C.** and Bruno, T.J., “Application of pressure-controlled advanced distillation curve analysis: Virgin and Waste Oils” *Industrial & Engineering Chemistry Research*, **2013**, *52(1)*, 327-337.
7. **Windom, B.C.**, Bruno, T.J. “Pressure-Controlled Advanced Distillation Curve Analysis of Biodiesel Fuels: Assessment of Thermal Decomposition” *Energy & Fuels*, **2012**, *26(4)*, 2407-2415.
8. **Windom, B.C.**, Huber, M.L., Bruno, T.J., Lown, A.L., Lira, C.T., “Measurements and Modeling Study on a High-Aromatic Diesel Fuel” *Energy & Fuels*, **2012**, *26(3)*, 1787-1797.
9. **Windom, B.C.**, Bruno, T.J., “Assessment of the Composition and Distillation Properties of Thermally Stressed RP-1 and RP-2: Application to Fuel Regenerative Cooling” *Energy & Fuels*, **2011**, *25(11)*, 5200-5214.
10. Bruno, T.J., **Windom, B.C.**, “Method and Apparatus for the Thermal Stress of Complex Fluids: Application to Fuels” *Energy & Fuels*, **2011**, *25(6)*, 2625-2632.
11. Bruno, T.J., **Windom, B.C.**, “Chromatographic sample collection from two-phase flows” *Journal of Chromatography A*, **2011**, *1218(48)*, 8594-8599.
12. **Windom, B.C.**, Sawyer, W.G., and Hahn, D.W., “A Raman spectroscopic study of MoS₂ and MoO₃: applications to tribological systems” *Tribology Letters*, **2011**, *42(3)*, 301-310.
13. **Windom, B.C.**, Lovestead, T.M., Mascal, M., Nitkin, E.B., and Bruno, T.J., “Advanced distillation curve analysis on ethyl levulinate as a diesel fuel oxygenate and a hybrid biodiesel fuel” *Energy & Fuels*, **2011**, *25(4)*, 1878-1890.
14. Lovestead, T.M., **Windom, B.C.**, Riggs, J.R., Nickell, C., and Bruno, T.J., “Assessment of the Compositional Variability of RP-1 and RP-2 with the Advanced Distillation Curve Approach” *Energy & Fuels*, **2010**, *24(10)*, 5611-5623.
15. **Windom, B.C.** and Bruno, T.J., “Novel reduced pressure-balance syringe for chromatographic analysis” *Journal of Chromatography A*, **2010**, *1217(47)*, 7434-7439.

16. **Windom, B.C.** and Bruno, T.J., “Improvements in the measurement of distillation curves. 5. reduced pressure composition-explicit approach” *Industrial & Engineering Chemistry Research*, **2011**, 50(2), 1115-1126.
17. Lovestead, T.M., **Windom, B.C.** and Bruno, T.J., “Application of the Advanced Distillation Curve Method to the Development of Cuphea-Derived Biodiesel Fuel,” *Energy and Fuels*, **2010**, 24(6), 3665–3675.
18. **Windom, B.C.**, Lovestead, T.M. and Bruno, T.J., “Application of the Advanced Distillation Curve Method to the Development of Unleaded Aviation Gasoline,” *Energy and Fuels*, **2010**, 24(5), 3275–3284.
19. **Windom, B.C.**, Hahn, D.W. “Laser ablation-laser induced breakdown spectroscopy (LA-LIBS): A means for overcoming matrix effects leading to improved analyte response” *Journal of Analytical Atomic Spectroscopy*, **2009**, 24(12), 1665-1675.
20. **Windom, B.C.**, Diwakar, P.K., and Hahn D.W. “Dual-pulse LIBS for analysis of gaseous and aerosol systems: plasma-analyte interactions” *Spectrochimica Acta Part B*, **2006**, 61, 788-796.

CONFERENCE PROCEEDINGS

1. Curtis, C.*, Patz, B., Bruno, T.J., **Windom, B.C.**, “Combustion and Flame Behaviors of Endothermic Fuels”, *Proceedings for the Western States Section of the Combustion Institute Spring Meeting*, Seattle, WA, March 21-23, 2016.
2. Won, S.H., Reuter, C.B., Nakane, S., **Windom, B.C.**, Ju, Y., “Effect of Ignition on Turbulent Premixed Flames of n-Heptane and Toluene”, *53rd AIAA Aerospace Sciences Meeting*, Orlando, FL, January 5-9, **2015**.
3. Burke, S., **Windom, B.C.**, “Derived Measurement of the Enthalpy of Vaporization of Complex Fuels Using a Variable Pressure Distillation Curve Approach”, *249th ACS National Meeting*, Denver, CO, March 22-26, **2015**.
4. Patz, B., **Windom, B.C.**, “Azeotropic Volatility Behavior of Hydrous Ethanol Gasoline Mixtures”, *249th ACS National Meeting*, Denver, CO, March 22-26, **2015**.
5. Lefkovitz, J., **Windom, B.C.**, Uddi, M., MacDonald, W., Adams, S., Ju, Y., “Time Dependent Measurements of Species Formation in Nanosecond-Pulsed Plasma Discharges in C₂H₄/O₂/Ar Mixtures”, *52nd AIAA Aerospace Sciences Meeting*, National Harbor, MD, January 13-17, **2014**.
6. **Windom, B.C.**, Won, S.H., Jiang, B., Ju, Y., Hammack, S., Ombrello, T., Carter, C., “Detailed Characterization of Low Temperature Chemistry and Turbulence Interaction in Reactor-Assisted Turbulent Premixed Flames”, *52nd AIAA Aerospace Sciences Meeting*, National Harbor, MD, January 13-17, **2014**.
7. **Windom, B.C.**, Won, S.H., Jiang, B., Ju, Y., “Detailed Characterization of Low Temperature Chemistry and the Influence on Turbulent Burning velocities for n-Heptane and Iso-Octane Reactor-

Assisted Turbulent Flames”, *Western States Section of the Combustion Institute Technical Meeting*, Fort Collins, CO, October 7-8, **2013**.

8. **Windom, B.C.**, Won, S.H., Jiang, B., Ju, Y., “Studies of Turbulent Flame Propagation and Chemistry Interaction at Elevated Temperatures and High Reynolds Numbers”, *8th U.S. National Combustion Meeting*, Park City, UT, May 19-22, **2013**.
9. **Windom, B.C.**, Won, S.H., Wada, T., Jiang, B., Ju, Y., “Study of Turbulent Flame Propagation and Surface Characteristics at Large Reynolds Numbers”, *51st AIAA Aerospace Sciences Meeting*, Grapevine, TX, January 7-10, **2013**.
10. Uddi, M., Lefkovitz, J., **Windom, B.C.**, Ju, Y., “Species Measurements of Ethylene Oxidation in a Nanosecond-Pulsed Plasma Discharge Using QCL Absorption Spectroscopy Near 7.6 μ m”, *51st AIAA Aerospace Sciences Meeting*, Grapevine, TX, January 7-10, **2013**.
11. **Windom, B.C.**, Xiouris, C., Fincham, A.M., Egolfopoulos, F.N., “A Study of Spherically Expanding Flames Using Particle Image Velocimetry” *2012 Spring Technical Meeting of the Western States Sections of the Combustion Institute*, Arizona State University, AZ, March 19-20, **2012**.
12. Eisazadeh-Far, K., **Windom, B.C.**, Jayachandran, J., Fincham, A.M., Egolfopoulos, F.N., “An Experimental Study of Spherically Expanding Flames and the Determination of Laminar Flame Speeds” *2011 Fall Technical Meeting of the Western States Sections of the Combustion Institute*, University of California at Riverside, CA, October 16-18, **2011**
13. **Windom, B.C.**, Lovestead, T.M. and Bruno, T.J., “Assessment of the Compositional Variability of RP-1 and RP-2 with the Advanced Distillation Curve Approach” *Proceedings of the 57th JANNAF Propulsion Meeting*, Colorado Springs, CO, US, May 3-7, **2010**.

ADDITIONAL PUBLICATIONS AND ARTICLES IN PREPARATION

1. Burke, S., **Windom, B.C.**, “Derived Measurement of the Enthalpy of Vaporization of Complex Fuels Using a Variable Pressure Distillation Curve Approach”, *In Preparation*, **2016**.
2. Bahar, A., Patz, B., **Windom, B.C.**, “Azeotropic Volatility Behavior of Anhydrous and Hydrated Ethanol Gasoline Mixtures”, *In Preparation*, **2016**.
3. Baston, J., **Windom, B.C.**, “Processing of planar laser induced fluorescence images to isolate flame edges and quantify flame length scales”, *In Preparation*, **2016**.
4. **Windom, B.C.** and Hahn, D.W., “Raman Spectroscopy”. In Wang, Q. and Chung, Y.W. (Eds.) *Encyclopedia of Tribology*, Springer, **2013**.
5. Bruno, T.J., Fortin, T.J., **Windom, B.C.**, Widegren, J.A., “Thermophysical properties of thermally stressed RP-1 and RP-2 for application to fuel regenerative cooling: a comprehensive report” *Submitted to NIST Journal of Research*, **2012**.

RECENT PRESENTATIONS (* indicates presenting author, full list available upon request)

1. Rhoads, R., Burke, S., **Windom, B.C.***, “DOE-VFP: The volatility of ethanol-gasoline fuels and its impact on particulate matter emissions from spark ignition engines” National Renewable Energy Laboratory, Golden, CO, August 18, 2016.
2. Burke, S. C., Rhoads, R., Ratcliff, M., McCormick, R., Windom, B. C., “Distillation-based Droplet Modeling of Non-ideal Oxygenated Gasoline Blends”, *Rocky Mountain Fluid Mechanics Research Symposium 2016*, Boulder, CO, August 9, 2016.
3. Rhoads, R., Burke, S. C., , Ratcliff, M., McCormick, R., Windom, B. C., “Optimized Fuel Composition and Operating Parameters for Ethanol-Gasoline Direct Injection Spark Ignition Engines”, *Rocky Mountain Fluid Mechanics Research Symposium 2016*, Boulder, CO, August 9, 2016.
4. Curtis, C., Gowing, D., Windom, B. C., Owens, J., Lowe, L., Bruno, T., "Combustion of Endothermic Fuels", *UCCS Mountain Lion Research Day*, Colorado Springs, CO, April 8, 2016.
5. Burke, S. C., Patz, B., Windom, B. C., "Distillation curve based approach to evaluating hydrous ethanol volatility and heat of vaporization of other complex fuels", *UCCS Mountain Lion Research Day*, Colorado Springs, CO, April 8, 2016.
6. Curtis, C.*, Patz, B., Bruno, T.J., **Windom, B.C.**, “Combustion and Flame Behaviors of Endothermic Fuels”, *Western States Section of the Combustion Institute Spring Meeting*, Seattle, WA, March 21-23, 2016.
7. **Windom, B.C.***, “The Role of Low Temperature Fuel Ignition Chemistry on Premixed Turbulent Flame Structures, Propagation, and Stability”, *Mechanical Engineering Department Seminar – Colorado State University*, Fort Collins, CO, February 11, 2016.
8. Curtis, C.*, **Windom, B.C.**, “The Effect of Thermal Stress on the Combustion of Endothermic Fuels”, *4th AIAA-Rocky Mountain Technical Symposium*, Golden, CO, November 6, 2015.
9. Burke, S.*, **Windom, B.C.**, “Derived Measurement of the Enthalpy of Vaporization of Complex Fuels Using a Variable Pressure Distillation Curve Approach”, *4th AIAA-Rocky Mountain Technical Symposium*, Golden, CO, November 6, 2015.
10. Burke, S., **Windom, B.C.***, “Derived Measurement of the Enthalpy of Vaporization of Complex Fuels Using a Variable Pressure Distillation Curve Approach”, *19th Symposium of Thermophysical Properties*, Boulder, CO, June 22-26, **2015**.
11. Patz, B., **Windom, B.C.***, “Azeotropic Volatility Behavior of Hydrous Ethanol Gasoline Mixtures”, *19th Symposium of Thermophysical Properties*, Boulder, CO, June 22-26, **2015**.
12. Burke, S.*, **Windom, B.C.**, “Derived Measurement of the Enthalpy of Vaporization of Complex Fuels Using a Variable Pressure Distillation Curve Approach”, *249th ACS National Meeting*, Denver, CO, March 22-26, **2015**.
13. Patz, B.*, **Windom, B.C.**, “Azeotropic Volatility Behavior of Hydrous Ethanol Gasoline Mixtures”, *249th ACS National Meeting*, Denver, CO, March 22-26, **2015**.
14. Won, S.H.*, Reuter, C.B., Nakane, S., **Windom, B.C.**, Ju, Y., “Effect of Ignition on Turbulent Premixed Flames of n-Heptane and Toluene”, *53rd AIAA Aerospace Sciences Meeting*, Orlando, FL, January 5-9, **2015**.
15. Bruno, T.J., **Windom, B.C.***, “Thermally Stressed Fuels: Relationship of Thermophysical Properties to Combustion”, *Multi-Agency Coordinating Committee for Combustion Research (MACCCR) 7th Annual Fuel and Combustion Research Review*, Boulder, CO, October 27-30, **2014**.

16. **Windom, B.C.***, “The Role of Low Temperature Fuel Chemistry on Premixed Turbulent Flame Structures, Propagation, and Stability”, *Invited Presentation at Colorado State University*, Fort Collins, CO, October 28, **2014**.
17. Bruno, T.J.*, Fortin, T.J., **Windom, B.C.**, Widegren, J.A., “Thermophysical Properties of Thermally Stressed RP-1 and RP-2”, *3rd AIAA-Rocky Mountain Technical Symposium*, October 24, **2014**.
18. Curtis, C.*, **Windom, B.C.**, “The Effect of Thermal Stress on the Combustion of Endothermic Fuels”, *3rd AIAA-Rocky Mountain Technical Symposium*, October 24, **2014**.
19. Lefkovitz, J.*, Uddi, M., **Windom, B.C.**, Lou, G., Ju, Y., “*In situ* species diagnostics and kinetic study of plasma activated ethylene pyrolysis and oxidation in a low temperature flow reactor”, *Proceedings of Combustion Institute*, August 3-8, **2014**.
20. **Windom, B.C.**, Won, S.H.*, Jiang, B., Ju, Y., Hammack, S., Ombrello, T., Carter, C., “Impacts of turbulence-Chemistry Interaction and Low Temperature Ignition on Premixed n-Heptane/Air Flames”, *Proceedings of Combustion Institute*, August 3-8, **2014**.
21. Lefkovitz, J.*, **Windom, B.C.**, Uddi, M., MacDonald, W., Adams, S., Ju, Y., “Time Dependent Measurements of Species Formation in Nanosecond-Pulsed Plasma Discharges in C₂H₄/O₂/Ar Mixtures”, *52st AIAA Aerospace Sciences Meeting*, National Harbor, MD, January 13-10, **2014**.
22. **Windom, B.C.***, Won, S.H., Jiang, B., Ju, Y., Hammack, S., Ombrello, T., Carter, C., “Detailed Characterization of Low Temperature Chemistry and Turbulence Interaction in Reactor-Assisted Turbulent Premixed Flames”, *52st AIAA Aerospace Sciences Meeting*, National Harbor, MD, January 13-10, **2014**.

AWARDS

- First Prize in Artistic Merit at the U.S. National Combustion Meeting art competition, 2013
- National Academy of Science/National Research Council postdoctoral associateship program 2009-2011
- Elsevier Science prize for best poster presentation at 2006 LIBS conference, Montreal, Canada, Sept 2006

PROFESSIONAL AFFILIATIONS

- Member of Pi Tau Sigma engineering honor society
- Member of The Combustion Institute
- Member of the American Society of Mechanical Engineers
- Member of the American Institute of Aeronautics and Astronautics