

TANVIR FAROUK, Ph.D.

ASSISTANT PROFESSOR

DEPARTMENT OF MECHANICAL ENGINEERING

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PROFESSIONAL EXPERIENCE

- 2012 – present *Assistant Professor*, Department of Mechanical Engineering
University of South Carolina, Columbia, SC, USA
- 2011 – 2012 *Associate Research Scientist*, Department of Mechanical & Aerospace Engineering
Princeton University, Princeton, NJ, USA
- 2009 – 2011 *Postdoctoral Scholar*, Department of Mechanical & Aerospace Engineering
Princeton University, Princeton, NJ, USA
- 2001 – 2002 *Lecturer*, Department of Mechanical Engineering
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

EDUCATION

- 2009 *Ph.D., Mechanical Engineering*, Drexel University, Philadelphia, PA, USA
Dissertation: “Modeling and Simulations of DC and RF Atmospheric Pressure Non-thermal Micro Plasma Discharge: Analysis and Applications”
Summa Cum Laude
- 2004 *M.A.Sc., Mechanical Engineering*, University of Toronto, Toronto, ON, Canada
Dissertation “Measurement of Adsorption for Pressures Very Close to Saturation Vapor Pressure”
Magna Cum Laude
- 2001 *B.Sc., Mechanical Engineering*
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh
Magna Cum Laude

HONORS/AWARDS

- DARPA *Micro Technology Office (MTO)* Grant: “*High Carrier Density, Fast Switching Microscale Plasma Devices Enabled by Exploitation of Plasma Instabilities and High Pressure*” 2011.
- National Science and Engineering Research Council of Canada (NSERC) Post doctoral Fellowship 2009
- George Law Fellowship 2008 – 2009
- Gordon Research Conference Travel Fellowship 2006, 2008
- George Hill Jr. Fellowship 2007 – 2008
- Drexel University Research Excellence Award 2007 – 2008

- National Science Foundation Travel Fellowship 2007, 2008
- Outstanding Teaching Assistant Award, Drexel University 2006 – 2007 (*Honorable mention*)
- University of Toronto Fellowship 2002 – 2004
- Presidential Scholarship University of Western Ontario 2002 (*Declined*)
- Dean's List Award, Bangladesh University of Engineering and Technology 1999 – 2001
- Merit Scholarship, Bangladesh University of Engineering and Technology 1996 – 2001

RESEARCH INTERESTS

- Plasma Engineering
- Energy Systems
- Multi-physics Modeling
- Computational Fluid Dynamics
- Hybrid Models
- Reacting Flows
- Alternative & Next Generation Fuels

RESEARCH EXPERIENCE

2011 – present

Associate Research Scientist

Princeton University, Department of Mechanical and Aerospace Engineering

2009 – 2011

Post doctoral Research Scholar

Princeton University, Department of Mechanical and Aerospace Engineering

Supervisor: Frederick Dryer

Research: Characterization of alternative fuels e.g. biofuels (ethanol, butanol), biodiesels (methyl butanoate, methyl decanoate), Study of diffusion flames in normal and zero gravity conditions; Multiphase model development for studying microgravity droplet combustion with detailed chemical kinetics and adaptive grid refinement; Study of extinction phenomena (radiative and diffusive) in droplet combustion; Development of statistical narrow band radiative heat transfer model for isolated droplet combustion, Kinetics of droplet combustion for a variety of fuels (alkanes, alcohols, esters, biofuels); Soot dynamics and soot model development in droplet combustion; Multi processor Large Eddy Simulation (LES) model development for studying turbulence, chemistry and heterogeneous wall catalysis interaction in flow reactors; Development of surrogate fuels for jet fuels to develop detailed chemical kinetics model; Chemical kinetic model for surrogate jet fuel.

2005 – 2009

Drexel University, Department of Mechanical Engineering and Mechanics

Graduate Research Assistant

Advisors: Alexander Fridman, Bakhtier Farouk

Research: Development and utilization of atmospheric pressure micro plasmas for sustainable energy applications, materials fabrication and biological decontamination; Characterization of non-thermal micro plasma discharges using optical emission spectroscopy and mass spectrometry.

Translational, rotational and vibrational temperature measurements in atmospheric pressure non-equilibrium micro plasma; Speciation measurements in high pressure micro plasma discharge; Development of multi dimensional hybrid model (electrons treated kinetically and heavy particles treated as continuum) for a variety of gases (argon, hydrogen, helium, methane) to study the interplaying physico-chemical processes and instability in micro plasmas; Development of models for DC and RF powered discharges for methane feed for predicting diamond like carbon thin film deposition through plasma enhanced chemical vapor deposition (PECVD).

2003 – 2005

University of Toronto, Department of Mechanical and Industrial Engineering

Graduate Research Assistant

Advisor: Charles Ward

Research: Study of contact angle hysteresis and water adsorption in glass surface; Designed an experimental setup to conduct ground base contact angle hysteresis experiments; Developed a numerical method to calculate contact angle, interface shape and liquid phase pressure from measurements of the meniscus height using thermodynamic equilibrium conditions; Analyzed turbulent bifurcation in Marangoni convections.

TEACHING EXPERIENCE

Teaching Assistant, Drexel University

College of Engineering

Introduction to Thermodynamics (January 2009 – March 2009)

Department of Mechanical Engineering and Mechanics

Heat Transfer (September 2008 – December 2008)

Thermal and Fluid Sciences Laboratory (April 2006 – June 2006)

Teaching Assistant, University of Toronto

Department of Mechanical and Industrial Engineering

Fundamentals of Computer Programming (January 2004 – April 2004)

Lecturer, Bangladesh University of Engineering and Technology (BUET)

Department of Mechanical Engineering (August 2001 – July 2002)

Engineering Numerical Analysis, Engineering Mechanics – Dynamics and Statistics

Heat Engine Laboratory, Thermal and Fluid Sciences

SUPERVISION EXPERIENCE

- **Alyssa Wilson** (April 2007 – September 2007)
NSF funded Research Experience for Undergraduates (REU)
Development of a model to simulate species separation in a Ranque-Hilsch vortex tube due to Soret diffusion.
- **Drexel Research Experience for Teachers Summer Program** (June 2005 – September 2005)
Mentored high school teachers in emerging research topics and research projects.
- **Anita Rebarchak** (April 2005 – June 2005)

NSF funded Research Experience for Undergraduates (REU)

Design and fabrication of a reactor chamber for atmospheric pressure micro plasma discharge characterization.

PROFESSIONAL SERVICES AND ACTIVITIES

REVIEWER SERVICE

- Plasma Physics & Controlled Fusion
- Plasma Chemistry & Plasma Processing
- 34th International Symposium on Combustion
- IEEE Transactions on Plasma Science
- Journal of Physics D: Applied Physics
- International Journal of Heat & Mass Transfer
- Energy & Fuels
- Energies
- Combustion Science & Technology
- Combustion Theory and Modelling

PROFESSIONAL MEMBERSHIPS

- American Society of Mechanical Engineers (ASME)
- American Chemical Society (ACS)
- Institute of Electrical and Electronic Engineers (IEEE)
- Combustion Institute (CI)
- American Association for the Advancement of Science (AAAS)
- American Institute of Aeronautics & Astronautics (AIAA)

PUBLICATIONS

PEER-REVIEWED JOURNAL ARTICLES

1. **Farouk, T.**, Liu, Y., Avedisian, C. Dryer, F., “Combustion studies of large methyl ester droplets: methyl decanoate” *Combustion and Flame* (in Review).
2. Guo, H., Sun, W., Haas, F., **Farouk, T.**, Dryer, F., Ju, Y., “Measurement of H₂O₂ in low temperature dimethyl ether (DME) oxidation” *Proceedings of the Combustion Institute* (in Review).
3. **Farouk, T.**, Liu, Y., Savas, A., Avedisian, C. Dryer, F., “Sub-millimeter sized methyl butanoate droplet combustion: Microgravity experiments and detailed numerical modeling” *Proceedings of the Combustion Institute* (in Review).
4. **Farouk, T.**, Dryer, F., “On the extinction of alcohol droplet combustion under microgravity conditions” *Combustion and Flame*, 159, (2012), 3208 – 3223.
5. Dooley, S., Won, S., Heyne, J., **Farouk, T.**, Ju, Y., Dryer, F., “The experimental evaluation of a methodology to surrogate fuel formulation for the emulation of combustion kinetic phenomena by a theory of real fuel oxidation” *Combustion and Flame*, 159, (2012), 1444 – 1466.
6. **Farouk, T.**, Dryer, F., “Tethered methanol droplet combustion in carbon dioxide enriched environment under microgravity conditions” *Combustion and Flame*, 159, (2012) 200 – 209.
7. **Farouk, T.**, Dryer, F., “Microgravity droplet combustion: Effect of tethering fiber on burning rate and flame structure” *Combustion Theory and Modelling*, 15, (2011) 487 – 515.

8. **Farouk, T.**, Farouk, B., Fridman, A., “Computational studies of atmospheric pressure methane-hydrogen micro glow discharge” *IEEE Transactions on Plasma Science*, 38, (2010) 73 – 85.
9. **Farouk, T.**, Farouk, B., Gutsol, A., “Simulation of species and temperature separation in the Ranque-Hilsch vortex tube using the large eddy simulation technique” *International Journal of Heat and Mass Transfer*, 52, (2009) 3320 – 3333.
10. Wilson, A., Staack, D., **Farouk, T.**, Gutsol, A., Fridman, A., Farouk, B., “Self rotating DC atmospheric pressure discharge over a water-surface electrode” *Plasma Sources Science and Technology*, 17, (2008) 045001-1 – 12.
11. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Atmospheric pressure methane – hydrogen micro plasma discharge for thin film deposition” *Journal of Physics D: Applied Physics*, 41, (2008), 175202 -1 – 19.
12. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Atmospheric pressure radio frequency glow discharges in argon: effect of external circuit parameters” *Plasma Sources Science and Technology*, 17, (2008), 035015-1 – 15.
13. **Farouk, T.**, Farouk, B., “Large eddy simulations of the flow field and temperature separation in the Ranque-Hilsch vortex tube” *International Journal of Heat and Mass Transfer*, 50, (2007), 4724 – 4735.
14. **Farouk, T.**, Farouk, B., Staack, D., Gutsol, A., Fridman, A., “Modeling of direct current micro-plasma discharges in atmospheric pressure hydrogen” *Plasma Sources Science and Technology*, 16, (2007), 619 – 634.
15. Wu, J., **Farouk, T.**, Ward, C., “Pressure dependence of the contact angle” *Journal of Physical Chemistry B*, 111, (2007), 6189 – 6197.
16. **Farouk, T.**, Farouk, B., Staack, D., Gutsol, A., Fridman, A., “Simulation of DC atmospheric pressure argon micro glow-discharge” *Plasma Sources Science and Technology*, 15, (2006), 676-688.

BOOK ARTICLE

- **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Simulation of atmospheric pressure non-thermal Plasma discharges for surface decontamination applications” *Plasma Assisted Decontamination of Chemical and Biological Agents*, Editors: S. Guceru and V. Smirnov, Springer, NY 2008, pp. 291 – 300.

SELECTED CONFERENCE PUBLICATIONS

1. **Farouk, T.**, Dryer, F. L., “On the extinction characteristics of alcohol droplet combustion under microgravity conditions – a numerical study” *Fall Technical Meeting of the Eastern States Section of the Combustion Institute*, Storrs, Connecticut, October 9 – 12, 2011, 10 pages on compact disc.
2. **Farouk, T.**, Dooley, S., Dryer, F. L., “Large eddy simulation of turbulence and surface catalysis interaction in a variable pressure flow reactor” *Fall Technical Meeting of the Eastern States Section of the Combustion Institute*, Storrs, Connecticut, October 9 – 12, 2011, 8 pages on compact disc.
3. **Farouk, T.**, Dryer, F., “Methanol droplet combustion in carbon dioxide enriched environments: Extinction characteristics” *7th US National Combustion Meeting of the Combustion Institute*, Atlanta, Georgia, March 20 – 23, 2011, 7 pages on compact disc.
4. Serinyel, Z., Dooley, S., **Farouk, T.**, Jahangirian, S., Curran, H., Dryer, F., “A pyrolytic flow reactor study of iso-propanol” *7th US National Combustion Meeting of the Combustion Institute*,

- Atlanta, Georgia, March 20 – 23, 2011, 7 pages on compact disc.
5. Dooley, S., **Farouk, T.**, Dryer, F. L., “Gas phase decomposition of methyl formate” *Preprint Paper, American Chemical Society, Division of Fuel Chemistry*, 2010, 55 (1), 1-3.
 6. **Farouk, T.**, Dryer, F., Marchese, Vaughn, T., Kroenlein, K., “A numerical study on the impact of supporting fibers on tethered droplet ignition under microgravity conditions” *Spring Technical Meeting of the Western States Section of the Combustion Institute*, Boulder, Colorado, March 21 – 23, 2010, 8 pages on compact disc.
 7. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Two dimensional simulation of atmospheric pressure methane-hydrogen micro discharge for thin film deposition” *19th International Symposium on Plasma Chemistry*, Bochum Germany, July 26 – 31, 2009, 4 pages on compact disc.
 8. Farouk, B., **Farouk, T.**, Staack, D., Gutsol, A., Fridman, A., “Atmospheric pressure micro plasma discharge for net shape deposition and micro fabrication” *Proceedings of 2008 National Science Foundation CMMI Engineering Research and Innovation Conference*, Knoxville, Tennessee, January 7 – 10, 2008, 14 pages on compact disc.
 9. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Simulations of atmospheric pressure non thermal plasma discharges for surface decontamination applications” *NATO Advanced Study Institute Plasma Decontamination*, Çeşme, Turkey, September 16 – 26, 2007, 10 pages on compact disc.
 10. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Simulation of atmospheric pressure methane – hydrogen micro-discharge for diamond like carbon (DLC) film deposition” *IEEE Pulsed Power and Plasma Science Conference*, Albuquerque, New Mexico, June 17 – 22, 2007, pp. 728 – 731.
 11. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Numerical modeling of an atmospheric pressure methane-hydrogen micro-discharge” *18th International Symposium on Plasma Chemistry*, Kyoto Japan, August 26 – 31, 2007, pp. 220.
 12. **Farouk, T.**, Farouk, B., Fridman, A., “Numerical modeling of an atmospheric pressure micro glow discharge” *The 33rd IEEE International Conference on Plasma Science*, Traverse City, Michigan, June 4 – 8, 2006, pp. 262.
 13. **Farouk, T.**, Farouk, B., Gutsol, A., and Fridman, A., “Two dimensional simulations of an atmospheric pressure micro glow-discharge”, *3rd International Workshop on Microplasmas*, Greifswald, Germany, May 9 – 11, 2006, IWM 2006 Proceedings, pp. 103.

SELECTED CONFERENCE PRESENTATIONS

1. **Farouk, T.**, Dryer, F., “A numerical study on the extinction characteristics of droplet combustion under microgravity conditions” **Invited Oral Presentation**, *50th AIAA Aerospace Sciences Meeting*, Nashville, Tennessee, January 9 – 12, 2012.
2. **Farouk, T.**, Dryer, F., “Methanol droplet combustion in carbon dioxide enriched environments: Extinction characteristics” *7th US National Combustion Meeting of the Combustion Institute*, Atlanta, Georgia, March 20 – 23, 2011.
3. **Farouk, T.**, Haas, F. M., Won, S. H., Chaos, M., Ju, Y., Dryer, F. L., “Experimental and kinetic modeling study of *n*-nonane oxidation” *33rd International Symposium on Combustion*, Beijing, China, August 1 – 6, 2010.
4. **Farouk, T.**, Dryer, F. L., “Simulation of *n*-nonane droplet combustion in microgravity: Burning rate, flame structure and extinction characteristics” *33rd International Symposium on Combustion*, Beijing, China, August 1 – 6, 2010.

5. **Farouk, T.**, Dryer, F. L., “A numerical study on the impact of tethering fibers on droplet combustion under microgravity conditions” *38th COSPAR Scientific Assembly*, Bremen, Germany, July 18 – 25, 2010.
6. **Farouk, T.**, Farouk, B., “Atmospheric pressure direct current micro glow discharge simulations: Effect of external circuit” *62nd Annual Gaseous Electronics Conference*, Saratoga Springs, New York, October 20 – 23, 2009.
7. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Quantifying neutrals and radicals in atmospheric pressure DC methane-hydrogen micro glow discharge using mass spectrometry” *Gordon Research Conference on Plasma Processing Science*, Mount Holyoke College, South Hadley, Massachusetts, July 13 – 18, 2008.
8. **Farouk, T.**, “Atmospheric pressure radio frequency plasma discharges for surface decontamination” *NSF CMMI Engineering Research and Innovation Conference*, Knoxville, Tennessee, January 7 – 10, 2008.
9. **Farouk, T.**, Farouk, B., Fridman, A., Gutsol, A., “Simulation of atmospheric pressure plasma discharges for surface decontamination applications” *NATO Advanced Study Institute Plasma Decontamination*, Çeşme, Turkey, September 16 – 26, 2007.
10. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Simulation of atmospheric pressure methane – hydrogen micro discharge for diamond like carbon (DLC) film deposition” *The 34th IEEE International Conference on Plasma Science*, Albuquerque, New Mexico, June 17 – 22, 2007.
11. **Farouk, T.**, Staack, D., Farouk, B., Gutsol, A., Fridman, A., “Plasma assisted net shape deposition for micro-fabrication – Characterization of an atmospheric pressure micro glow discharge” *NSF Grantees and Research Conference*, St Louis, Missouri, July 24 – 27, 2006.
12. **Farouk, T.**, Farouk, B., Gutsol, A., Fridman, A., “Numerical modeling of atmospheric pressure hydrogen micro discharge” *Gordon Research Conference on Plasma Processing Science*, Mount Holyoke College, South Hadley, Massachusetts, July 16 – 21, 2006.