

# Prasoon Diwakar

## Education

---

### **Ph.D. in Mechanical Engineering** | 2009

UNIVERSITY OF FLORIDA, Gainesville, FL

- Advisor: Prof. D.W. Hahn, Department of Mechanical and Aerospace Engineering
- Thesis: "Laser-induced plasmas as an analytical source for quantitative analysis of gaseous and aerosol systems: Fundamentals of plasma-particle interactions."

### **M.S. in Mechanical Engineering** | 2006

UNIVERSITY OF FLORIDA, Gainesville, FL

### **B.Tech in Mechanical Engineering** | 2003

INDIAN INSTITUTE OF TECHNOLOGY, Kanpur, India

## Areas of Specialization

---

- Laser-Produced Plasmas
- Laser-Based Diagnostic Methods
- Emission Spectroscopy
- Ultrafast Laser Ablation
- Cold Atmospheric Plasmas and Electroporation
- Thermal Sciences
- Heat Transfer and Fluid Mechanics
- Aerosol Measurement and Instrumentation

## Research Interests

---

- Development of Laser-and Spark Induced Breakdown Spectroscopy (LIBS/SIBS)
- Fundamentals of Ultrafast Laser Ablation
- Fundamentals of Plasma-Particle Interactions
- Isotope Detection Using LIBS and LA-ICP-MS
- Aerosol Systems and Aerosol Chemical Composition Measurement
- Real-Time Instrumentation
- Study and Diagnostics of Environmental Pollutants
- Combustion Diagnostics

## Experimental Techniques

---

- Laser-Induced Breakdown Spectroscopy (LIBS)
- Spark-Induced Breakdown Spectroscopy (SIBS)
- Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)
- Ultrafast Laser Ablation & Ultrafast Spectroscopy
- Cold Atmospheric Plasma and Electroporation for Biomedical applications
- Optical Diagnostic Techniques, including Rayleigh Scattering, Thomson Scattering, Laser-Induced Fluorescence (LIF), Laser Induced Incandescence (LII), and Raman Spectroscopy

## Patents

---

- P Kulkarni, PK Diwakar, Method and apparatus for aerosol analysis using optical spectroscopy, US Patent US8970840 B2.
- PK Diwakar, A Hassanein, Synergistic Effect of Photoporation, Cold Atmospheric Plasma and Electroporation for Biomedical Applications, Patent pending (provisional filed).

## Academic/Research Experience

---

### **Assistant Professor** | 2018 to Present

DEPARTMENT OF MECHANICAL ENGINEERING, SDSMT

- Supervisor: Dr. P. Larochelle
- Research Topics: Laser-Induced Breakdown Spectroscopy; Cold Atmospheric Plasmas and Electroporation for Biomedical Applications; Sensor Development for Mining applications; STEM Education

### **Post-Doctoral Associate** | 2012 to 2018

DEPARTMENT OF NUCLEAR ENGINEERING, Purdue University

- Advisor: Dr. A. Hassanein
- Research Topics: Femtosecond Laser ablation; Inductively Coupled- Mass Spectrometry; High Energy Density Plasmas; Ultrafast Laser Spectroscopy; Laser-Induced Breakdown Spectroscopy; Cold Atmospheric Plasmas for Biomedical Applications.

### **Inventor in Residence** | 2017 to Present

FROST SCIENCE MUSEUM, Miami

- Research Topics: Development of optical and analytical methods for carcinogen detection. Development of spectroscopy based public outreach experiments.

### **National Research Council Post-Doctoral Associate** | 2009 to 2012

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, CDC Cincinnati

- Advisor: Dr. P.S. Kulkarni
- Research Topic: Development of novel direct reading instruments for real-time measurement of fine and ultra-fine aerosols using plasma spectroscopy techniques (Laser, Spark, Microwave-induced breakdown spectroscopy- LIBS/SIBS/MIPS).

### **Graduate Research Assistant** | 2004 to 2009

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING, University of Florida

- Advisor: Dr. D.W. Hahn
- Research Topic: Study of plasma-particle interactions in laser-induced plasmas; Study of soot formation using laser-induced incandescence.

### **Visiting Scientist** | 2009

INSTITUTE OF ANALYTICAL SCIENCES, Dortmund, Germany

- Advisor: Dr. K. Niemax
- Research Topic: Investigation of single particle atomization in Inductively Coupled Plasma.

### **Student Research Assistant** | Summer 2002

LABORATORIO DI COMBUSTIONE E DIAGNOSTICHE LASER, Milano, Italy

- Advisor: Dr. G. Zizak CNR-TEMPE
- Research Topic: 2-dimensional imaging of soot volume fraction in flames using two-color emission technique and extinction methods.

## Teaching and Mentoring Experience

---

### Assistant Professor | 2018 to Present

DEPARTMENT OF MECHANICAL ENGINEERING, SDSMT

- Taught Heat Transfer class (ME 313) with 50 students for two semesters
- Mentored and advised five undergraduate students for undergraduate research

### Post-Doctoral Associate | 2012 to 2018

DEPARTMENT OF NUCLEAR ENGINEERING, Purdue University

- Advised 35 first-year students in TECH 120 Design Thinking in Technology course in 2016, 2018
- Mentored and advised five Ph.D. students, three Masters students, and 15 undergraduate students.
- Advised two visiting international graduate students during summers 2013 and 2014.
- Mentoring activities included: informative lectures and seminars on laser-produced plasma, spectroscopy, optics and plasma physics; instructional guidance on experimental set up, lasers and other instruments; designing experiments and discussions; and overseeing manuscripts through the revision process. Also developed optics and spectroscopy outreach program for school students.

### Inventor in Residence | 2017 to Present

FROST SCIENCE MUSEUM, Miami

- Mentored 3 undergraduate students and 2 high school students.
- Engaged with general public including students of all ages in topics related to spectroscopy, optics, public health, STEM research in general.

## Refereed Publications

---

- D.M. Krug, P.K. Diwakar, A. Hassanein, 2019. A Temporal Study of Cell Death Signaling Responses to Cold Atmospheric Plasma and Electroporation in Human Cancer Cells, IEEE Transactions on Plasma Science, In Press.
- P.C. Dieffenbach, C.M. Borkowski, A. M. Elseid, P.K. Diwakar, A. Hassanein, 2019. Effects of laser wavelength on aluminum plasma in transverse magnetic fields. Physics of Plasma 26 (4), 043302
- A. M. Elseid, P.C. Dieffenbach, P.K. Diwakar, A. Hassanein, 2018. Nanosecond Laser-Metal Ablation at Different Ambient Conditions. Spectrochimica Acta Part B: Atomic Spectroscopy 143, 26-31.
- A. M. Elseid, P.K. Diwakar, A. Hassanein, 2018. Comprehensive studies of ultrashort laser pulse ablation of tin target at terawatt power. Spectrochimica Acta Part B: Atomic Spectroscopy 139, 57-62.
- T. Sizyuk, J.P. Oliver, P.K. Diwakar, 2017. Mechanisms of carbon dimer formation in colliding laser-produced carbon plasmas. Journal of Applied Physics 122 (2), 023303.
- G. Sinclair, J.K. Tripathi, P.K. Diwakar, A. Hassanein, 2017. Melt layer erosion during ELM-like heat loading on molybdenum as an alternative plasma-facing material. Scientific reports 7 (1), 12273.
- G. Sinclair, J.K. Tripathi, P.K. Diwakar, M. Witz, J. Linke, A. Hassanein, 2017. Structural evolution of tungsten surface exposed to sequential low-energy helium ion irradiation and transient heat loading. Nuclear Materials and Energy, 12, 405-411.
- A. M. Elseid, P.K. Diwakar, M. Polek, A. Hassanein, 2016. Dynamics of Low- and High-Z Metal Ions Emitted during Nanosecond Laser-Produced Plasmas. J. of Applied Physics, 120, 173104.

## Refereed Publications (cont.)

- A. M. Elseid, N. C. Termini, P.K. Diwakar, A. Hassanein, 2016. Characteristics of Ions Emission from Ultrashort Laser Produced Plasma. *Scientific Reports*, 6.
- G. Sinclair, J.K. Tripathi, P.K. Diwakar, A. Hassanein, 2016. Structural response of transient heat loading on a molybdenum surface exposed to low-energy helium ion irradiation. *Nuclear Fusion* 56 (3), 036005.
- J.R. Becker, P. J. Skordzki, P.K. Diwakar, A. Hassanein, 2016. Double-pulse neodymium YAG/Carbon dioxide laser-induced breakdown spectroscopy for excitation of bulk and trace analytes. *Spectroscopy Letters* 49 (4), 276-284.
- P. J. Skordzki, J.R. Becker, P.K. Diwakar, S.S. Harilal, A. Hassanein, 2016. A comparative study of single-pulse and double-pulse LIBS With U containing samples. *Applied spectroscopy* 70, 467-473.
- V. Raman, I. Camarillo, A. Garner, P.K. Diwakar, S. Madhivanan, M. Raakesh, R. Sundarajan, 2015. Irreversible electroporation of aggressive triple-negative breast cancer cells. *Electrical Insulation and Dielectric Phenomena (CEIDP)*, 2015 IEEE Conference, 624-627.
- S.S. Harilal, P.K. Diwakar, N.L. Lahaye, M.C. Phillips, 2015. Spatio-temporal evolution of uranium emission in laser-produced plasmas. *Spectrochimica Acta B*, 111:1-7.
- S.S. Harilal, P.K. Diwakar, M. P. Polek, M.C. Phillips, 2015. Morphological changes in ultrafast laser ablation plumes with varying spot size. *Optics express*, 23(12):15608-15615.
- N.L. LaHaye, J. Kurian, P.K. Diwakar, L. Alff, S.S. Harilal, 2015. Femtosecond laser ablation-based mass spectrometry: An ideal tool for stoichiometric analysis of thin films. *Scientific Reports*, 5:13121.
- S.S. Harilal, P.K. Diwakar, N.L. LaHaye, M.C. Phillips, 2015. Spatio-temporal evolution of uranium emission in laser-produced plasmas. *Spectrochimica Acta B*, 111:1-7.
- P.K. Diwakar, S.S. Harilal, M.C. Phillips, A. Hassanein, 2015. Characterization of ultrafast laser-ablation plasma plumes at various Ar ambient pressures. *Journal of Applied Physics*, 118, 043305.
- G.L. Jackson, C.P. Chobrak, A.G. McLean, R. Maingi, D.K. Mansfield, A.L. Roquemore, P.K. Diwakar, A. Hassanein, A. Lietz, D.L. Rudakov, T. Sizyuk, J. Tripathi, 2015. Effect of lithium in the DIII-D SOL and plasma-facing surfaces. *Journal of Nuclear Materials*, 463:1160-1164.
- J.R. Freeman, P.K. Diwakar, S.S. Harilal, A. Hassanein, 2014. Improvements in discrimination of bulk and trace elements in long-wavelength double pulse LIBS. *Spectrochimica Acta B*, 102:36-41.
- P.K. Diwakar, S.S. Harilal, M.C. Phillips, A. Hassanein, 2014. Expansion dynamics of ultra- fast laser produced plasmas in the presence of ambient argon. *Journal of Applied Physics*, 116, 133301.
- N.L. LaHaye, S.S. Harilal, P.K. Diwakar, A. Hassanein, 2014. Characterization of laser ablation sample introduction plasma plumes in fs-LA-ICP-MS *Journal of Analytical and Atomic Spectrometry*, 29: 2267-2274.
- N.L. LaHaye, S.S. Harilal, P.K. Diwakar, A. Hassanein, 2014. Persistence of U emission in laser-produced plasmas. *Journal of Applied Physics*, 115 Art. No.163301.
- P.K. Diwakar, J.J. Gonzalez, R.E. Russo, S.S. Harilal, A. Hassanein, 2014. Ultrafast laser ablation ICP-MS: Role of spot size, laser fluence, and repetition rate on signal intensity and elemental fractionation. *Journal of Analytical and Atomic Spectrometry*, 29:339-346.
- S.S. Harilal, N. Farid, J.F. Freeman, P.K. Diwakar, N.L. LaHaye, A. Hassanein, 2014. Background gas collisional effects on expanding fs and ns laser ablation plumes. *Applied Physics A* 117 (1), 319-326.
- N.L. LaHaye, S.S. Harilal, P.K. Diwakar, A. Hassanein, 2013. The effect of laser-pulse duration on ICP-MS signal intensity, elemental fractionation, and detection limits in fs-LA- ICP-MS. *Journal of Analytical and Atomic Spectrometry*, 28: 1781-1787.

## Refereed Publications (cont.)

- S.S. Harilal, P.K. Diwakar, A. Hassanein, 2013. Electron-ion relaxation time dependent signal enhancement in ultrafast double-pulse laser-induced breakdown spectroscopy. *Applied Physics Letters*, 103.
- P.K. Diwakar, S.S. Harilal, N.L. LaHaye, A. Hassanein, P. Kulkarni, 2013. The influence of laser pulse duration and energy on ICP-MS signal intensity, elemental fractionation, and particle size distribution in NIR fs-LA-ICP-MS. *Journal of Analytical and Atomic Spectrometry*, 28:1420-1429.
- N.L. LaHaye, S.S. Harilal, P.K. Diwakar, A. Hassanein, 2013. The effect of ultrafast laser wavelength on ablation properties and implications on sample introduction in inductively coupled plasma mass spectrometry *Journal of Applied Physics*, 114, Art. No. 023103.
- P.K. Diwakar, S.S. Harilal, J.R. Freeman, A. Hassanein, 2013. Role of laser pre-pulse wavelength and inter-pulse delay on signal enhancement in collinear double-pulse laser-induced breakdown spectroscopy. *Spectrochimica Acta B*, 87:43-50.
- J.R. Freeman, S.S. Harilal, P.K. Diwakar, B. Verhoff, A. Hassanein, 2013. Comparison of optical emission from ns and fs LPP in atmosphere and vacuum conditions. *Spectrochimica Acta B*, 87:65-73.
- A.E. Hussein, P.K. Diwakar, S.S. Harilal, A. Hassanein, 2013. The role of laser wavelength on plasma generation and expansion of ablation plumes in air. *Journal of Applied Physics*, 113, Art. No. 143305.
- B. Verhoff, S.S. Harilal, J.R. Freeman, P.K. Diwakar, A. Hassanein, 2012. Dynamics of femto- and nanosecond laser ablation plumes investigated using optical emission spectroscopy. *Journal of Applied Physics*, 112, Art. No. 093303.
- S.S. Harilal, G.V. Miloshevsky, P.K. Diwakar, N.L. LaHaye, A. Hassanein, 2012. Experimental and computational study of complex shockwave dynamics in laser ablation plumes in Argon atmosphere. *Physics of Plasmas*, 19 Art.No.083504.
- P.K. Diwakar, P.S. Kulkarni, 2012. Measurement of Elemental Concentration of Aerosols Using Spark Emission Spectroscopy. *Journal of Analytical and Atomic Spectrometry*, 27:1101- 1109.
- P.K. Diwakar, K.H. Loper, A.M. Matiaske, D.W. Hahn, 2012. Laser-induced breakdown spectroscopy for analysis of micro- and nanoparticles. *Journal of Analytical and Atomic Spectrometry*, 27:1110-1119.
- P.K. Diwakar, P.S. Kulkarni, M.E. Birch, 2012. New approach for near-real-time measurement of elemental composition of aerosols using laser-induced breakdown spectroscopy. *Aerosol Science and Technology*, 46:316-332.
- P.K. Diwakar, S. Groh, K. Niemax, D. W. Hahn, 2010. Study of analyte dissociation and diffusion in laser-induced plasmas: Implications for laser-induced breakdown spectroscopy. *Journal of Analytical Atomic Spectrometry*, 25:1921-1930.
- S. Groh, P.K. Diwakar, C.C. Garcia, A. Murtazin, K. Niemax, D.W. Hahn, 2010. 100% efficient sub-nanoliter sample introduction in laser-induced breakdown spectroscopy and inductively-coupled plasma spectrometry: Implications for ultralow sample volumes. *Analytical Chemistry*, 82: 2568-2573.
- P.K. Diwakar, D.W. Hahn, 2008. Study of early laser-induced plasma dynamics: transient electron density gradients via Thomson scattering and the implications on LIBS measurements. *Spectrochimica Acta B*, 63:1038-1046.
- P.K. Diwakar, P. B. Jackson, D. W. Hahn, 2007. Investigation of multi-component aerosol particles and the effect on quantitative laser-induced breakdown spectroscopy: consideration of

## Refereed Publications (cont.)

- localized matrix effects. *Spectrochimica Acta B*, 62, 1466-1474.
- C. A. Henry, P.K. Diwakar, D.W. Hahn, 2007. Investigation of helium addition for laser-induced plasma spectroscopy of pure gas phase systems: analyte interactions and signal enhancement. *Spectrochimica Acta B*, 62, 1390-1398.
- B.C. Windom P.K. Diwakar, D.W. Hahn, 2006. Dual-pulse LIBS for analysis of gaseous and aerosol systems: plasma-analyte interactions, *Spectrochimica Acta B*, 61, 788-796.
- G.D. Yoder P.K. Diwakar, D.W. Hahn, 2005. Assessment of soot particle vaporization effects during laser-induced incandescence using time-resolved light scattering. *Applied Optics*, 44, 4211-4219.

## Book Chapters

- P.K. Diwakar, 2014. Chapter 2, Laser induced breakdown spectroscopy for analysis of aerosols in *Laser-Induced Breakdown Spectroscopy Theory and Applications*; Editors: S. Musazzi and U. Perini, Springer Series in Optical Sciences 182, Chapter 9, pp 227-255.
- S. S. Harilal, J. R. Freeman, P.K. Diwakar, A. Hassanein, Submitted. Chapter 6, *Femtosecond Laser Ablation: Fundamentals and Applications in Laser-Induced Breakdown Spectroscopy Theory and Applications*; Editors: S. Musazzi and U. Perini Springer Series in Optical Sciences 182, Chapter 6, pp 143-166.

## Presentations/Conference Proceedings

- SciX 2017, Reno, NV (Talk). Oct 2017 “Ion Dynamics and Ablation Dynamics of Femtosecond and Nanosecond Laser Produced Plasmas.”
- SciX 2017, Reno, NV (Poster). Oct 2017 “A Temporal Study of Cell Death Signal Responses to Cold Atmospheric Plasma and Electroporation in Human Cancer Cells.”
- SciX 2016, Minneapolis, MN (Invited Talk). Oct 2016 “Novel Analytical Application of LIBS Using External Electric and Magnetic Fields.”
- SciX 2016, Minneapolis, MN (Poster). Oct 2016 “Synergy of Cold Atmospheric Plasma and Electroporation for Treatment of Cancer Cells.”
- SciX 2015, Providence, RI (Invited Talk). Oct 2015 “Understanding the Complex Mechanisms Leading to Signal Enhancement in Double Pulse LIBS.”
- SciX 2014, Reno, NV (Talk). Oct 2014 “Ultrafast laser ablation plume hydrodynamics: Implications for analytical applications.”
- SciX 2013, Milwaukee, WI (Talk). Oct 2013 “Mechanisms leading to signal enhancement in NIR fs-fs and NIR ns-ns double-pulse laser-induced breakdown spectroscopy.”
- SciX 2013, Milwaukee, WI (Poster). Oct 2013 “Dynamics of ultrafast-laser ablation plumes in the presence of gases: Implications for LA-ICP-MS and LIBS.”
- SciX 2013, Milwaukee, WI (Poster). Oct 2013 “Provenance study of native copper using fs-LA-ICP-MS.”
- SciX 2013, Milwaukee, WI (Poster). Oct 2013 “Effects of axial and transverse magnetic fields on laser-produced plasmas.”
- SciX 2012, Kansas City, WI (Poster). Oct 2012 “From Sample to Signal: A Comprehensive Study of the Influence of Laser Parameters on fs-LA-ICP-MS.”
- FACSS 2011, Reno, NV (Invited Talk). Oct 2011 “Role of Analyte Diffusion in Laser-Induced Plasmas.”

**Presentations/Conference Proceedings (cont.)**

---

- 30<sup>th</sup> Annual AAAR Conference, Orlando, FL (Talk). Oct 2011 “Near Real-time Elemental Analysis of Aerosols Using Spark-induced Breakdown Spectroscopy”.
- 3<sup>rd</sup> North American Symposium on LIBS, Clearwater, FL (Poster). Jul 2011 “Corona-Assisted Microwave Plasma Spectroscopy (CAMPS) for Aerosol Analysis.”
- 29<sup>th</sup> Annual AAAR Conference, Portland, OR (Talk). Oct 2010 “Semi-Continuous Measurement of Elemental Composition of Aerosol Particles Using Laser-Induced Breakdown Spectroscopy.”
- 6<sup>th</sup> International Conference on Laser-Induced Breakdown Spectroscopy, Memphis, USA (poster). Sept 2009 “Novel Approach for Analysis of Fine and Ultra-Fine Aerosol Particles Using Laser-Induced Breakdown Spectroscopy.”
- 2<sup>nd</sup> North American Symposium on LIBS, New Orleans (Poster). Jul 2009 “Investigation of Plasma-Particle Interactions in LIBS by Introduction of Single Droplet (Picolitre Volume) in the Plasma.”
- 2<sup>nd</sup> North American Symposium on LIBS, New Orleans, USA (Poster). Jul 2009 “Elemental Distribution in Fish Scales Using LIBS and LA-ICP-MS Methods.”
- 5<sup>th</sup> International Conference on Laser-Induced Breakdown Spectroscopy, Berlin, Germany (poster). Sept 2008 “Temporal investigation of aerosol particles and early plasma dynamics on single isolated analyte droplets.”
- Conference on Lasers and Electro-Optics (CLEO), San Jose, CA. May 2008 “Laser-induced breakdown spectroscopy (LIBS) for aerosol analysis.”
- 4<sup>th</sup> International Conference on Laser-Induced Breakdown Spectroscopy, Montreal, Canada (poster). Sept 2006 “Investigation of multi-component aerosol particles and the effect on quantitative analysis: consideration of thermal matrix effects.”
- 29<sup>th</sup> International Symposium of Combustion, Sapporo, Japan (poster). Jul 2002 “Quantitative two-dimensional imaging of soot volume fraction in flames.”

**Awards**

---


- CappSci Inventor Prize for carcinogen detection. 2015.
- Early Career Award by Society for Applied Spectroscopy at SCIX conference. 2013.
- Charles C. Shepard Science Award Nominee for Outstanding Scientific Publication (Centers for Disease Control and Prevention) 2011.
- Research Associateship Award by National Academy of Sciences for Postdoc at NIOSH Cincinnati 2009.
- Poster Prize for student poster presentation at 2nd NASLIBS conference, New Orleans, USA Jul 2009.
- Nominated for Elsevier/Spectrochimica Acta Atomic Spectroscopy Best Paper Award. 2008.
- Nominated for Elsevier/Spectrochimica Acta Atomic Spectroscopy Best Paper Award. 2007.
- Second Prize for Poster Presentation at 9<sup>th</sup> Environmental Engineering Society Poster Symposia, University of Florida. April 2007.
- Elsevier Prize, Best Student Poster Presentation, 4<sup>th</sup> International Conference on LIBS, Montreal, Canada. Sep 2006.
- Indian Institute of Technology Kanpur Certificate of Merit for Academic Excellence in Mechanical Engineering. Aug 1998.



## Professional and Service Organizations

---

- Editorial Board member of Purdue Working Paper Series on navigating careers in academics, 2018-2020.
- Member of Optical Society of America (OSA), Society for Applied Spectroscopy (SAS), North American Society for Laser-Induced Breakdown Spectroscopy (NASLIBS).
- Faculty Advisor of Society of Applied Spectroscopy Chapter at Purdue University, 2017-present.
- Technical meeting Lead (topical meetings, incubators) of OSA Applied Spectroscopy Technical group, 2015-2016
- Session chair NASLIBS session on fundamentals of laser ablation at SCIX2017.
- Chair and Organizer of First Annual Symposium on Applied Spectroscopy and Photonics, Purdue University, Sep 2017.
- Organizer of Science Talks Series at Purdue, 2017-2018.
- Secretary and Council member of North American Society for Laser-Induced Breakdown Spectroscopy (NASLIBS) 2013-2015.
- Member of Esther Hoffman Beller Award Committee, 2012-2013.
- Reviewer of Journal of Analytical Atomic Spectrometry, Physical Chemistry Chemical Physics, Analyst, Optics Letters, Optics Express, Applied Spectroscopy, Analytical Chemistry, Applied Optics, AIChE Journal, Spectrochimica Acta B, Sensors, Applied Physics A, Chinese Optics Letters, Physics of Plasmas, Journal of Applied Physics, NIOSH manuscripts.
- President of Florida chapter of charity organization Asha for Education, 2006-2008



6/25/2020