



# Mark E. Fuller, Ph.D.

## *Curriculum Vitæ*

### Education

- 2019 **Doctor of Philosophy, Chemical and Biochemical Engineering**, *Brown University*, Providence, RI USA.
- Dissertation: "Design and Construction of a Shock Tube Facility for Investigations of Nitrogenated Fuel Additives"
  - Member of Prof. C. F. Goldsmith's research group
  - Experimental and computational investigations of chemical reactions and kinetics relevant to combustion processes
  - Focus on combustion chemistry of nitrogenated fuel additives and associated processes:
    - Experimental investigation into pyrolysis and dissociation of nitrite and nitrate compounds
    - Experimental investigation into reactivity enhancement using isopropyl nitrate as dopant
    - Computational modeling of HONO/HNO<sub>2</sub> and interactions with fuel molecules and fragments
  - Design and construction of diaphragmless shock tube for experimental research
- 2015 **Master of Science, Chemical and Biochemical Engineering**, *Brown University*, Providence, RI USA.
- Member of Prof. C. F. Goldsmith's research group
  - Coursework in chemical kinetics, thermodynamics, quantum mechanics, statistical mechanics, physical chemistry, heat and mass transfer, numerical solution of partial differential equations
- 2011 **Master of Science, Mechanical Engineering**, *Cornell University*, Ithaca, NY USA.
- Studied combustion and emissions of solid biomass particles under Profs. Frederick Gouldin and Elizabeth Fisher
  - Additional work in study of microgravity combustion of single fuel droplets under Prof. C.T. Avedisian

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- 2009 **Bachelor of Science, Engineering**, *Brown University*, Providence, RI USA.
- Majored in Mechanical Engineering: Energy Conversion and Fluid and Thermal Systems
  - Also completed all courses for Aerospace Applications and Engineering Mechanics programs in Mechanical Engineering
  - Graduated Magna Cum Laude and elected to Tau Beta Pi, Sigma Xi, and Phi Beta Kappa
  - Additional coursework in German Studies and Public Policy

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## Experience

- 2019–2021 **Postdoctoral Researcher**, *RWTH Aachen University*, Aachen, Germany.
- Physico-Chemical Fundamentals of Combustion (PCFC) Group under Prof. Alex Heufer
  - Research lead for nitrogen combustion chemistry
  - Experimental investigation and kinetic mechanism development for bio- and renewable liquid transportation fuels
  - Ignition delay studies in both shock tubes and rapid compression machines
  - Mechanical design and testing of a high-pressure diaphragmless shock tube valve
- 2018 **Guest Researcher**, *Institut de Combustion Aérothermique Réactivité et Environnement*, Orléans, France.
- Performed shock tube ignition delay studies on effect of isopropyl nitrate as dopant in propane combustion under Dr. Nabiha Chaumeix
  - Ignition delay results are applied to modeling efforts for engine performance and chemical kinetic mechanism development and evaluation
  - Additional ethanol-air ignition delay studies conducted in support of the Rapid Compression Machine Workshop 2nd Characterization Initiative
- 2016 **Guest Graduate Appointment**, *Argonne National Laboratory*, Lemont, IL USA.
- Performed shock tube studies of propyl nitrite pyrolysis under Dr. Robert S. Tranter
  - Captured data on time-history of reaction using laser schlieren densitometry
  - Developed model for decomposition and fit rate constant for initial dissociation of propyl nitrite
- 2014–2019 **Adjunct Lecturer and Teaching Assistant**, *Brown University*, Providence, RI USA.
- Instructor for senior design course ENGN 1720: Design of Thermal Engines (2014–2018)
  - Additional role as teaching assistant for ENGN 1700: Jet Engines and Aerospace Propulsion (2014, 2016–2018) and ENGN 0720: Thermodynamics (2019)

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- 2011–2014 **Mechanical Engineer**, *Naval Undersea Warfare Center*, Newport, RI USA.
- Member of Propulsion and Energy Branch for Autonomous and Unmanned Systems
  - Testing and computer modeling of fuel cell and battery systems
  - Development of vehicle sizing analyses
  - Oxygen/Hydrogen Hazards Analysis Team - review and approve safety of test assemblies and experimental uses of oxygen and hydrogen
  - Information Assurance Work Force - Linux administrator
  - Radiation Safety Officer for Division Newport

## Technical Skills

|                              |  |   |
|------------------------------|--|---|
| Data Collection and Analysis | LabVIEW, Arduino, Raspberry Pi                 | <i>Construction of data acquisition systems including hardware integration and software logging both with commercial systems and custom construction</i>  |
| Scientific Programming       | Git, Python, Fortran, Matlab/Octave            | <i>Competent in scientific programming and scripting for analysis, simulation, and modeling; version-control and managed software development</i>   |
| Mechanical Design            | 3-D CAD, Solidworks, Comsol; Machine operation | <i>Ability to design and analyze mechanical and laboratory apparatus; experienced in machine operation and fabrication - CNC mill, lathe, welding</i>   |
| Documentation                | LaTeX, LibreOffice, MS Office                  | <i>Significant experience in developing written documentation and presentations in both industrial and academic settings including refereed journal articles, technical reports, posters, and slide presentations</i> |

## Languages

|         |                  |   |
|---------|------------------|---|
| English | Native           |   |
| German  | Near-Native      | <i>Six semesters of formal study at university level, residence in Germany since 2019</i> |
| Spanish | Good Command     | <i>Six years of primary and secondary school study</i>                                    |
| French  | Basic Competence | <i>Independent study and guest research conducted in France</i>                           |
| Hebrew  | Basic Competence | <i>Independent study and Jewish education</i>   |

## Professional and Research Community Service

- Reviewer for Combustion and Flame
- Reviewer for Proceedings of the Combustion Institute
- Reviewer for Energy Conversion and Management

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- Contributing developer to the REACTION MECHANISM GENERATOR, AUTOMATIC RATE CALCULATOR, and THE TANDEM TOOL for automated computational chemistry and mechanism development, organized under the Green Research Group at MIT
- Member of the THEORETICAL CHEMICAL KINETICS DATABASE organized under the Dana Research Group at the Technion
- Active in formatting and publication of experimental data in CHEMKED format for open-access and handling and manipulation of data files with PYKED open-source software
- Team member maintaining the L<sup>A</sup>T<sub>E</sub>X MODERN CV package (used to generate this CV)

## Professional Memberships

- Combustion Institute: German Section since 2019, Eastern States Section 2014–2019
- Verein Deutscher Ingenieure (VDI)

## Awards and Honors

- Elected to membership in Tau Beta Pi, Sigma Xi, and Phi Beta Kappa, 2009
- Recipient of the Joseph Kestin Award of Excellence as top graduating engineering student at Brown University in the field of thermodynamics, 2009
- Winner of the Caesar Misch Prize for excellence as a first-year student in German language study at Brown University, 2006
- Achieved rank of Eagle Scout as member of the Boy Scouts of America, 2005
- Selected to attend the New Jersey Governor's School on Public Issues, 2004

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## Doctoral Dissertation

Fuller, Mark E. "Design and Construction of a Shock Tube Facility for Investigations of Nitrogenated Fuel Additives". PhD thesis. Brown University, May 2019. DOI: 10.13140/RG.2.2.28447.51366.

## Refereed Articles

- Döntgen, Malte, Mark E. Fuller, C. Franklin Goldsmith, and K. Alexander Heufer. "A shock tube laser schlieren study of the pyrolysis and decomposition of dimethoxy and trimethoxy methane". In: (2021). In preparation.
- Fuller, Mark E., Nabiha Chaumeix, and C. Franklin Goldsmith. "Laminar flame speeds and ignition delay times for isopropyl nitrate and propane blends". In: *Combustion and Flame* (2021). In preparation.
- Fuller, Mark E., C. Franklin Goldsmith, and K. Alexander Heufer. "Reactions on the potential energy surfaces of NO<sub>2</sub> and an alkyl radical". In: *Reaction Chemistry & Engineering* (2021). In preparation.
- Fuller, Mark E., Philipp Morsch, C. Franklin Goldsmith, and K. Alexander Heufer. "The impact of NO<sub>x</sub> addition on the ignition behavior of n-pentane". In: *Reaction Chemistry & Engineering* (2021). In preparation.
- Morsch, Philipp, Mark E. Fuller, and K. Alexander Heufer. "Rapid compression machine study and mechanism development for combustion of ethyl ester / pentane blends". In: (2021). In preparation.
- Preußker, Matthias, Mark E. Fuller, C. Franklin Goldsmith, and K. Alexander Heufer. "A rapid compression machine and laser schlieren shock tube investigation into the pyrolysis of di-tert butyl peroxide". In: (2021). In preparation.
- Fuller, M.E. and J. T. C. Liu. "Nanofluid flow and heat transfer of carbon nanotube and graphene platelet nanofluids in entrance region of microchannels". In: *Archives of Mechanics* 72.4 (2020), pp. 1–25. DOI: 10.24423/aom.3556.
- Barbosa De Castilho, Cintia Juliana, Mark E. Fuller, Aakash Sane, and Joseph T. C. Liu. "Nanofluid flow and heat transfer in boundary layers at small nanoparticle volume fraction: Non-zero nanoparticle flux at solid wall". In: *Heat Transfer Engineering* 40.9–10 (2019), pp. 725–737. DOI: 10.1080/01457632.2018.1442298.
- Chen, Xi, Mark E. Fuller, and C. Franklin Goldsmith. "Decomposition Kinetics for HONO and HNO<sub>2</sub>". In: *Reaction Chemistry & Engineering* 4.2 (2019), pp. 323–333. DOI: 10.1039/c8re00201k.
- Fuller, Mark E. and C. Franklin Goldsmith. "A shock tube laser schlieren study of the pyrolysis of isopropyl nitrate". In: *The Journal of Physical Chemistry A* 123.28 (2019), pp. 5866–5876. DOI: 10.1021/acs.jpca.9b03325.
- Fuller, Mark E. and C. Franklin Goldsmith. "On the relative importance of HONO and HNO<sub>2</sub> in low-temperature combustion". In: *Proceedings of the Combustion Institute* 37.1 (2019), pp. 695–702. DOI: 10.1016/j.proci.2018.06.208.
- Fuller, Mark E., Mal Skowron, Robert S. Tranter, and C. Franklin Goldsmith. "A modular, multi-diagnostic, automated shock tube for gas-phase chemistry". In: *Review of Scientific Instruments* 90.6 (2019), p. 064104. DOI: 10.1063/1.5095077.

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- Fuller, Mark E., Richard H. West, and C. Franklin Goldsmith. "A Computational Investigation into the Combustion Byproducts of a Liquid Monopropellant". In: *Proceedings of the Combustion Institute* 37.4 (2019), pp. 5671–5677. DOI: 10.1016/j.proci.2018.05.175.
- Randazzo, John B., Mark E. Fuller, C. Franklin Goldsmith, and Robert S. Tranter. "Thermal dissociation of alkyl nitrites and recombination of alkyl radicals". In: *Proceedings of the Combustion Institute* 37.1 (2019), pp. 703–710. DOI: 10.1016/j.proci.2018.05.085.
- Liu, J.T.C., M.E. Fuller, K.L. Wu, A. Czulak, A.G. Kithes, and C.J. Felten. "Nanofluid flow and heat transfer in boundary layers at small nanoparticle volume fraction: Zero nanoparticle flux at solid wall". In: *Archives of Mechanics* 69 (2017), pp. 75–100. URL: <http://am.ippt.pan.pl/am/article/view/v69p75>.
- Fuller, Mark E. "A Battery Model for Constant-Power Discharge including Rate Effects". In: *Energy Conversion and Management* 88 (2014), pp. 199–205. DOI: 10.1016/j.enconman.2014.08.015.

## Technical Reports

- Fuller, Mark E. *Aluminum-Silver Oxide Battery Leakage Current Analysis*. NUWC-NPT Technical Memo 14-038. Naval Undersea Warfare Center Division Newport, 2014.
- Fuller, Mark E. *Energy Modeling for LDUUV AoA*. NUWC-NPT Technical Memo 14-039. Naval Undersea Warfare Center Division Newport, 2014.
- Fuller, Mark E. *Gas-Liquid Separator Design for Knifefish*. NUWC-NPT Technical Memo 14-040. Naval Undersea Warfare Center Division Newport, 2014.
- Fontaine, Joseph H. and Mark E. Fuller. *Analysis of the Mk 48 Mod 6 and UK Spearfish Propulsion Systems from a Performance and Turnaround Cost Perspective*. NUWC-NPT Technical Memo 10-071. Naval Undersea Warfare Center Division Newport, 2013.
- Fuller, Mark E. *Generic Battery Rate-Effect Model*. NUWC-NPT Technical Memo 12-052. Naval Undersea Warfare Center Division Newport, 2012.

## Conference Presentations

- Fuller, Mark E., Malte Döntgen, Heiko Minwegen, Matthias Preußker, Alina Wildenberg, and K. Alexander Heufer. "NO<sub>x</sub>-Cycling Reactions of Oxy and Peroxy Radicals". In: *10th European Combustion Meeting*. Apr. 2021.
- Fuller, Mark E., Philipp Morsch, C. Franklin Goldsmith, and K. Alexander Heufer. "Reaction Class-Based CHON Combustion Mechanism Development". In: *10th European Combustion Meeting*. Apr. 2021.
- Fuller, Mark E., Mal Skowron, Robert S. Tranter, and C. Franklin Goldsmith. "A Diaphragmless, Fire-By-Wire Shock Tube for High-Temperature and Low-Pressure Kinetics". In: *11th US National Combustion Meeting*. 2019.
- Jacobs, S., T. Ottenwälder, C. Wouters, M.E. Fuller, M. Preußker, H. Minwegen, B. Lehrheuer, S. Pischinger, and K.A. Heufer. "Potential of bio-hybrid-fuels in homogeneous fuel-lean conditions of a combustion engine". In: *29. Deutscher Flammentag*. Poster presentation. 2019.
- Liu, J.T.C. and M.E. Fuller. "Nanofluid flow and heat transfer of Carbon Nanotubes and Graphene Platelettes Nanofluid in Entrance Region of Microchannels". In: *1st International Conference on Nanofluids*. 2019.

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- Ferliga, F., S. Dooley, M.S. Howard, S. Goldsborough, K.E. Niemeyer, B. Weber, Y. Yu, F. Foucher, B. Moreau, A. Farooq, G. Issyev, J. Santner, A. Zyada, A.O. Samimi, S.S. Vasu, G. Vanhove, N. Chaumeix, A. Comandini, M.E. Fuller, R. Schiessl, K.A. Heufer, R. Büttgen, E. Toulson, C. Wadkar, C. Strozzi, J. Sotton, and M. Bellenoue. "Rapid Compression Machine Workshop 2nd Characterization Initiative - Ethanol Ignition". In: *37th International Symposium on Combustion*. Poster presentation. 2018.
- Fuller, Mark E. and C. Franklin Goldsmith. "On the Modeling Implications of Treating HONO and HNO<sub>2</sub> as Distinct Chemical Species in Combustion". In: *Spring Technical Meeting Eastern States Section of the Combustion Institute*. Mar. 2018.
- Fuller, Mark E., John B. Randazzo, and Robert S. Tranter. "Shock Tube Experimental Investigation of Pyrolysis of Propyl Nitrite". In: *10th International Conference on Chemical Kinetics*. May 2017.
- Fuller, Mark E., John B. Randazzo, and Robert S. Tranter. "Shock Tube Study of Pyrolysis of Propyl Nitrite". In: *35th Regional Meeting on Kinetics and Dynamics*. Jan. 2017.
- Fuller, Mark E., Mal Skowron, and C. Franklin Goldsmith. "Brown Shock Tube: A Diaphragmless, Fire-By-Wire Apparatus". In: *10th US National Combustion Meeting*. Poster presentation. Apr. 2017.
- Fuller, Mark E. and C. Franklin Goldsmith. "Collisional Energy Transfer: Vibrationally Excited CH<sub>4</sub> in a N<sub>2</sub> Bath". In: *34th Regional Meeting on Kinetics and Dynamics*. Jan. 2016.
- Fuller, Mark E. and C. Franklin Goldsmith. "Collisional Energy Transfer: Vibrationally Excited CH<sub>4</sub> in a N<sub>2</sub> Bath". In: *International Combustion Institute Summer School on Near-Wall Reactive Flows*. Poster presentation. June 2016.
- Fuller, Mark E. and C. Franklin Goldsmith. "Design and Construction of a Next-Generation Diaphragmless Shock Tube". In: *International Combustion Institute Summer School on Near-Wall Reactive Flows*. Poster presentation. June 2016.
- Fuller, M.E., A.S. Soliman, E.M. Fisher, K.M. Zhang, F.C. Gouldin, and R.E. Thorne. "Micropowdered Biomass Combustion". In: *Cornell Center for a Sustainable Future*. Poster presentation. Oct. 2010.