**Christopher Eugene Shuck**

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**EDUCATION**

**University of Notre Dame** Notre Dame, IN

Ph.D., Chemical and Biomolecular Engineering 2013-2017

* Thesis: *Microstructure-reactivity Relationship for Gasless High-energy Density Materials*

**Princeton University** Princeton, NJ

B.S.E., Chemical and Biological Engineering 2009-2013

* Certificates in: Engineering Biology, Materials Science and Engineering
* Thesis: *Desorption Kinetics of Alkali Metal Atoms from Transition Metal Surfaces*

**RESEARCH EXPERIENCE**

Postdoctoral Researcher, **Drexel Nanomaterials Institute** Mar. 2018-Current

*Drexel University* Advisor: Yury Gogotsi Philadelphia, PA

* Develop and plan research directions focusing on synthesis of new MXenes for energy storage, electromagnetic shielding, and electrochromic devices
* Study the relationship between synthesis-structure-property of the MAX-MXene family of materials
* Pioneer research into compositional solid solution MXenes
* Apply for and manage multiple grants (DOE, IARPA, NSF, SBIR, etc.)
* Advise multiple Ph.D., undergraduate, and high school students. Implement customized research directions for each student, depending on their interests, skills, and talents

Doctoral Researcher, **Advanced Nanomaterials Laboratory** Oct. 2013-Feb. 2018

*University of Notre Dame*, Advisor: Alexander Mukasyan Notre Dame, IN

* Established five multidisciplinary international collaborations, including two with US national labs
* Synthesized and characterized heterogeneous nanocomposite particles for new materials synthesis and fundamental understanding of solid state kinetics for combustion systems
* Negotiated 15% reduction in service contracts saving $7,500 per year
* Implemented lab safety program to become only lab that was 100% compliant for five years in a row
* Mentored 2 graduate students and 3 undergraduate students

Fulbright Scholar, **Inorganic Nanomaterials Laboratory** Sept. 2016-Jun. 2017

*National University of Science and Technology*, Advisor: Alexander Rogachev Moscow, Russia

* Studied the dynamics of phase transition in high-energy density materials
* Utilized mechanical activation to enhance the chemical reactivity of solid-state reactions
* Characterized and analyzed solid materials using a variety of experimental techniques

PhD Intern, **Energetics Research Group** Jun. 2016-Sept. 2016

*Lawrence Livermore National Laboratory*, Advisor: Robert Reeves Livermore, CA

* Developed a new class of materials: structural energetics for defense applications
* Coordinated with multiple departments to plan and execute multidisciplinary project
* Planned and tested new safety procedures relating to energetic material testing

Research Intern, **Princeton Plasma Physics Laboratories** Sept. 2012-Jun. 2013

*Princeton University*, Advisor: Bruce KoelPrinceton, NJ

* Built and maintained ultra high vacuum equipment, including both commercial and custom devices
* Examined computational and theoretical models to model surface adsorbates
* Performed experiments to characterize and access liquid lithium surfaces after exposure to plasma

Research Intern, **Nanobiology and Structural Biology** Feb. 2011-Jun. 2013

*Princeton University*, Advisor: Janette CareyPrinceton, NJ

* Coordinated collaboration, leading to 25% increase in publications between the labs
* Trained eight students in both experimental and computational techniques
* Created high-throughput method of protein ion pair interaction quantification

Research Intern, **Structural Biology Lab**  May 2012-Sept. 2012

*Princeton University*, Advisor: Rudiger EttrichNove Hrady, CZ

* Determined protein energy landscapes through molecular dynamics studies
* Quantified ligand binding energy computationally and experimentally

**PUBLICATIONS**

* **C. E. Shuck** and Y. Gogotsi, “MXenes: A Tunable Family of 2D Carbides and Nitrides with Diverse Applications” Material Matters, under review
* D. Pinto, B. Anasori, H. Avireddy, **C. E. Shuck**, K. Hantanasirisakul, G. Deysher, J. R. Morante, W. Porzio, H. N. Alshareef, and Y. Gogotsi, “Synthesis and Electrochemical Properties of 2D Molybdenum Vanadium Carbides – Solid Solution MXenes,” Journal of Materials Chemistry A, Articles ASAP
* M. Han, **C. E. Shuck**, R. Rakhmanov, D. Parchment, B. Anasori, C. M. Koo, G. Friedman, and Y. Gogotsi, “Beyond Ti3C2T*x*: MXenes for Electromagnetic Interference Shielding,” ACS Nano, Articles ASAP
* L. Li, X. Fu, S. Chen, S. Uzun, A. Levitt, **C. E. Shuck**, W. Han, and Y. Gogotsi, “Hydrophobic and Stable MXene-polymer Pressure Sensors for Wearable Electronics,” ACS Applied Materials & Interfaces, vol. 12, pp. 15362-15369, 2020.
* J. Zhang, S. Uzun, S. Seyedin, P. Lynch, B. Akuzum, Z. Wang, S. Qin, M. Alhabeb, **C. E. Shuck**, W. Lei, E. Kumbur, W. Yang, X. Wang, G. Dion, and Y. Gogotsi, “MXene Liquid Crystals and Fibers,” ACS Central Science, vol. 6, pp. 254-265, 2020 .
* **C. E. Shuck**, A. Sarycheva, M. Anayee, A. Levitt, Y. Zhu, S. Uzun, V. Balitskiy, V. Zahrodna, O. Gogotsi, and Y. Gogotsi, “Scalable Synthesis of Ti3C2T*x* MXene,” Advanced Engineering Materials, vol. 22, pp. 1901241, 2020.
* G. Deysher, **C. E. Shuck**, N. Frey, A. Foucher, K. Maleski, A. Sarycheva, V. Shenoy, E. Stach, B. Anasori, and Y. Gogotsi, “Synthesis of Mo4VAlC4 MAX Phase and Two-Dimensional Mo4VC4 MXene with Five Atomic Layers of Transition Metals,” ACS Nano, vol. 14, pp. 204-217, 2020.
* W. Bao\*, **C. E. Shuck**\*, W. Zhang, X. Guo, Y. Gogotsi, and G. Wang, “Boosting Performance of Na-S Batteries Using Sulfur-Doped Ti3C2T*x* MXene Nanosheets with a Strong Affinity to Sodium Polysulfides,” ACS Nano, vol. 13, pp. 11500-11509, 2019.
* **C. E. Shuck**, M. Han, K. Maleski, K. Hantanasirisakul, S. J. Kim, J. Choi, W. Reil, and Y. Gogotsi, "Effect of Ti3AlC2 MAX Phase on Structure and Properties of Resultant Ti3C2T*x* MXene," ACS Applied Nano Materials, vol. 2, pp. 3368-3376, 2019.
* J. Li, L. An, H. Li, J. Sun, **C. Shuck**, X. Wang, Y. Shao, Y. Li, Q. Zhang, and H. Wang, “Tunable Stable Operating Potential Window for High-Voltage Aqueous Supercapacitors,” Nano Energy, vol. 63, pp. 103848, 2019.
* J. M. Pauls, **C. E. Shuck**, A. Genç, S. Rouvimov, and A.S. Mukasyan, "In-situ Transmission Electron Microscopy Determination of Solid-State Diffusion Kinetics in the Aluminum-Nickel System," Journal of Solid State Chemistry, vol. 276, pp. 114-121, 2019.
* M. Seredych, **C. E. Shuck**, D. Pinto, M. Alhabeb, E. Precetti, G. Deysher, B. Anasori, N. Kurra, and Y. Gogotsi, "High-Temperature Behavior and Surface Chemistry of Carbide MXenes Studied by Thermal Analysis," Chemistry of Materials, vol. 31, pp. 3324-3332, 2019.
* L. Yang, Y. Dall'Agnese, K. Hantanasirisakul, **C. E. Shuck**, K. Maleski, M. Alhabeb, G. Chen, Y. Gao, Y. Sanehira, A. K. Jena, L. Shen, C. Dall'Agnese, X.-F. Wang, and Y. Gogotsi, T. Miyasaka, "SnO2–Ti3C2 MXene Electron Transport Layers for Perovskite Solar Cells," Journal of Materials Chemistry A, vol. 7, pp. 5635-5642, 2019.
* P. Salles, D. Pinto, K. Hantanasirisakul, K. Maleski, **C. E. Shuck**, and Y. Gogotsi, "Electrochromic Effect in Titanium Carbide MXene Thin Films Produced by Dip‐Coating," Advanced Functional Materials, vol. 29, pp. 1809223, 2019.
* Q. Shan, X. Mu, M. Alhabeb, **C. E. Shuck**, D. Pang, X. Zhao, X. F. Chu, Y. Wei, F. Du, G. Chen, Y. Gogotsi, Y. Gao, and Y. Dall’Agnese, "Two-Dimensional Vanadium Carbide (V2C) MXene as Electrode for Supercapacitors with Aqueous Electrolytes," Electrochemistry Communications, vol. 96, pp. 103-107, 2018.
* K. Manukyan, J. Pauls, **C. Shuck**, S. Rouvimov, A. Mukasyan, K. Nazaretyan, H. Chatilyan, and S. Kharatyan, "Kinetics and Mechanism of Ignition in Reactive Al/Ni Nanostructured Materials," The Journal of Physical Chemistry C, vol. 122, pp. 27082-27092, 2018.
* A. S. Mukasyan, **C. E. Shuck**, J. M. Pauls, K. V. Manukyan, D. O. Moskovskikh, and A. S. Rogachev, "The Solid Flame Phenomenon: A Novel Perspective," Advanced Engineering Materials, vol. 20, pp. 1701065, 2018.
* J. M. Pauls, **C. E. Shuck**, and A. S. Mukasyan, "Micro-Heterogeneous Regimes for Gasless Combustion of Composite Materials," Combustion Science and Technology, vol. 190, pp. 893-908, 2018.
* **C. E. Shuck** and A. S. Mukasyan, "Kinetics of Heterogenerous Self-Propagating High-Temperature Reactions” Advanced Chemical Kinetics, pp. 167-196, 2018.
* A. S. Mukasyan and **C. E. Shuck**, "Kinetics of SHS Reactions: A Review," International Journal of Self-Propagating High-Temperature Synthesis, vol. 26, pp. 145-165, 2018.
* K. V. Manukyan, A. V. Yeghishyan, **C. E. Shuck**, D. O. Moskovskikh, S. Rouvimov, E. E. Wolf, A. S. Mukasyan, "Mesoporous Metal-Silica Materials: Synthesis, Catalytic and Thermal Properties," Microporous and Mesoporous Materials, vol. 257, pp. 175-184, 2018.
* A. Salvadori, S. Lee, A. Gillman, K. Matouš, **C. Shuck**, A. Mukasyan, M.T. Beason, I.E. Gunduz, S.F. Son, "Numerical and Experimental Analysis of the Young’s Modulus of Cold Compacted Powder Materials," Mechanics of Materials, vol. 112, pp. 56-70, 2017.
* **C. E. Shuck** and A. S. Mukasyan "Reactive Ni/Al Nanocomposites: Structural Characteristics and Activation Energy," The Journal of Physical Chemistry A, vol. 121, no. 6, pp. 1175–1181, 2017.
* **C. E. Shuck**, J. M. Pauls, A. S. Mukasyan "Ni/Al Energetic Nanocomposites and the Solid Flame Phenomenon," The Journal of Physical Chemistry C, vol. 120, no. 47, pp. 27066–27078, 2016.
* **C. E. Shuck**, M. Frazee, A. Gillman, M. T. Beason, I. E. Gunduz, K. Matouš, R. Winarski, A. S. Mukasyan "X-ray Nanotomography and Focused-Ion-Beam Sectioning for Quantitative Three-Dimensional Analysis of Nanocomposites," Journal of Synchrotron Radiation, vol. 23, no. 4 2016
* K. V. Manukyan, **C. E Shuck**, M. J. Cherukara, S. Rouvimov, D. Y. Kovalev, A. Strachan, A. S. Mukasyan "Exothermic Self-Sustained Waves with Amorphous Nickel," Journal of Physical Chemistry C, vol. 120, no. 10, pp. 5827-5838, 2016
* **C. E. Shuck**, K. V Manukyan, S. Rouvimov, A. S. Rogachev, A. S. Mukasyan, "Solid flame: Experimental Validation," Combustion and Flame, Combustion and Flame, vol. 163, pp. 487-493, 2016.
* K. V. Manukyan, A. G. Avetisyan, **C. E. Shuck**, H. A. Chatilyan, S. Rouvimov, S. L. Kharatyan, and A. S. Mukasyan, “Nickel Oxide Reduction by Hydrogen: Kinetics and structural transformations,” The Journal of Physical Chemistry C, vol. 119, pp. 16131–16138, 2015.
* K. V. Manukyan, W. Tan, R. J. deBoer, E. J. Stech, A. Aprahamian, M. Wiescher, S. Rouvimov, K. R. Overdeep, **C. E. Shuck**, T. P. Weihs, and A. S. Mukasyan, “Irradiation-Enhanced Reactivity of Multilayer Al/Ni Nanomaterials,” ACS Applied Materials and Interfaces, vol. 7, no. 21, pp. 11272–11279, 2015.
* K. V. Manukyan, **C. E. Shuck**, A. S. Rogachev, and A. S. Mukasyan, “Preparation and Reactivity of Gasless Nanostructured Energetic Materials,” Journal of Visualized Experiments, vol. 98, 2015.

**ORAL PRESENTATIONS**

* *Mo4VC4: a Two-dimensional MXene with 5 Atomic Layers of Transition Metals*, CIMTEC 2020 (Canceled due to COVID-19)
* *Scalable Synthesis of Ti3C2Tx MXenes*, at Materials Research Society Spring Meeting, 2020 (Canceled due to COVID-19)
* *Mo4VC4: a Two-dimensional MXene with 5 Atomic Layers of Transition Metals*, Beilstein Institute 2019
* *Effect of MAX Phase Synthesis on Resultant MXene Properties* at Materials Research Society Fall Meeting, 2018
* *Quantitative 3D Reconstruction of Reactive Nanocomposites: Effect of Nanostructure on Activation Energy* at International Symposium on Self-Propagating High-Temperature Synthesis, 2017
* *3-D Reconstruction of High Energy Density Materials: Effects of Nanostructure on Ignition Characteristic* at 4th Annual Midwest Imaging and Microanalysis Workshop, 2017
* *Reactive Nanocomposites: Surface Contact Area and Activation Energy of Ni-Al* at3rd International Conference on Nonisothermal Phenomena & Processes, 2017
* Keynote Presentation: *3D Reconstruction of High Energy Density Materials: Effects of Nanostructure on Ignition Characteristics* at International Symposium on Self-Propagating High-Temperature Synthesis, 2015
* *Solid Flame: Experimental Validation* at American Institute of Chemical Engineers Annual Meeting, 2014
* *Solid Flame: Experimental Validation* At IEEE Annual Mini-symposium on Electron Devices and Photonics, 2014

**AWARDS AND FELLOWSHIPS**

* Plug & Play Tech Center Startup Camp Award, April 2017
* Best Scientific Report at 3rd International Conference on Nonisothermal Phenomena & Processes, 2017
* Notre Dame Integrated Imaging Facility Award for Best Electron Beam Imaging Publication for 2016
* Fulbright Program, U.S. Department of State, Principal, Russia, 2016
* Carl Storm Underrepresented Minority Fellowship, June 2016
* Graduate Student Union Conference Presentation Grant, April 2016
* California Initiative Fund Recipient, April 2016
* 2nd Place for the Notre Dame Graduate Student Union Symposium Oral presentation, April 2016
* Oliver Langenberg ’35 Scholarship, 2013
* Charles Lockhart Scholarship 2010-2013
* William Randolph Heart Scholarship 2010-2011

**BUSINESS EXPERIENCE**

**McCloskey Business Plan Competition,** *Team Leader*2015-2017

* Founded and managed a team of students, including Ph.D. and MBA students
* Conducted market research, developed an original solution to the problem, and wrote a business plan detailing all aspects of the business
* Placed in the finals during the 2016-2017 competition, receiving the Plug & Play Tech Center Startup Camp Award ($75,000)

**Scientific Entrepreneurship,** *Business Class*Spring 2016

* Course in taking an invention to market, including market research, and writing a business plan

**LEADERSHIP EXPERIENCE**

**Materials Research Society**, *Government Affairs Committee* 2019-Present

* Worked with the grassroots subcommittee to facilities communication between the MRS community and national legislators
* Encouraged members to write personalized letters to national legislators to advocate for materials research

**MXene Symposium**, *Organizer*  2019

* Organized a symposium for 200+ attendees, including contacting and coordinating with presenters, managing accommodations, providing meals for all attendees, and organizing a sub-poster session within the symposium

**International Program**, *Campus Ambassador* 2015-2018

* Facilitated over twenty programs designed to for entire (1400+) international student body
* Led workshops for incoming international students including visas, finances, and transportation

**Graduate Student Union,** *Department Representative* 2014-2016

* Influenced campus-wide events and spending, directly led to 15% increased yearly budget
* Acted as liaison between administration and student body, leading 300% increase in events

**Princeton Alumni Interviewer** 2013-Present

* Interviewed over 75 students for admission into Princeton, 15 times the national average

**Colonial Club,** *Treasurer*  2011-2013

* Executed promotions which led to 100% increase in membership, while reducing expenses by 10%
* Managed team of 18 officers to plan, advertise, and execute events

**Outdoor Action,** *Trip Leader* 2010-2013

* Coordinated freshmen orientation program with over 60% of incoming students participating
* Lead a group of 10-12 freshmen on a wilderness trip; regulate supplies, plan route, report to command daily

**TEACHING/OUTREACH EXPERIENCE**

**Drexel University**

* ENGR220 Fundamentals of Materials (Recitation Instructor, 30 students) 2020
* ASM Materials Camp (Introduction to Materials Science, 45 students) 2019
* MATE-200 (Introduction to Materials Science, 75 students) 2019
* Drexel Emerging Graduate Scholars (Conference for PhD Students, 300+) 2018-2019

**University of Notre Dame** 2013-2015

* Chemical Engineering Thermodynamics (Required for Sophomores, over 100 students)
* Advanced Chemical Reaction Engineering (Graduate level course, including theory and computation)
* Chemical Engineering Laboratory I (Junior lab course, managed four experiments)
* Chemical Engineering Laboratory II (Senior lab course, managed four experiments)

**OTHER**

Languages: Intermediate Russian

Computer Skills: Matlab, Mathematica, Java, Python, SQL, Microsoft Office

Experimental Techniques: High-temperature High-pressure experiments, Focused Ion Beam (FIB) Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Synchrotron X-Ray Nanotomography, X-Ray Diffraction (XRD), Electrothermal Explosion (ETE), Differential Scanning Calorimetry (DSC), Mechanical Activation (MA), High-energy Ball-milling (HEBM), AvizoFire 3D Analysis, X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), Ultra-High Vacuum (UHV) experiments