Stephen A. Exarhos

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EDUCATION:

University of California, Riverside, Riverside, CA

Ph.D. in Mechanical Engineering September, 2018
Dissertation: "Nanoparticle Matter: Synthesis, Control, Characterization, and Application of YSZ, CZTS and ZrN"
Advisor: Dr. Lorenzo Mangolini

M.Ed. in Higher Education Administration & Policy December, 2018
Thesis: "A student-centered inclusive framework for promoting diversity in physics higher education"
Advisor: Dr. Eddie Comeaux

M.S. in Mechanical Engineering August, 2015
Thesis: "Aerosol Spray Pyrolysis Synthesis of CZTS Nanostructures"
Advisor: Dr. Lorenzo Mangolini

Lawrence University, Appleton, WI

B.A. in Physics June, 2012
Senior Thesis: "A Study of the In-Flight Dynamics of Soccer Balls"
Advisor: Dr. Jeff Collett

TEACHING EXPERIENCE:

Lecturer, Materials Science & Engineering Program Jan. 2020 - Present

University of California, Riverside

MSE 175A: Senior Design in Materials Science & Engineering

Weekly lectures guide professional development for senior-level undergraduate students in materials science and engineering. Lecture topics include: project design, surveying literature, ideation, engineering ethics, engineering economics, entrepreneurship, and navigating the job market.

Facilitate company and faculty partnerships to mentor five engineering design projects for student groups:

- Locally-sourced sustainable materials to support transportation infrastructure
- Locally-sourced sustainable materials for thermal & acoustic building insulation
- Vapor barrier weldable textile materials
- High-pressure, high-temperature, low-porosity sealants
- Agglomerated silicon-based anode material for lithium-ion batteries

Advise on project progress to ensure students meet goals with strict time constraints.

Academic Coordinator, Physics and Astronomy Department Sept. 2018 - Jan. 2020

University of California, Riverside

Was instructor of record for ~90 concurrent introductory physics lab sections each term. Manage ~45 teaching assistants and teach introductory physics labs.

Developed term-long seminar to engage graduate student teaching assistants in critical education theory and inclusive pedagogical practice.

Incorporated literature-backed pedagogy-, curriculum-, and inclusion-minded changes to lab activities and the departmental education culture.

Collaborated in the expansion and modernization of the advanced laboratory capstone course including developing new experiments and streamlining course administration. Advised on implementation of active learning techniques in introductory physics courses.

Managed budget and resources for upkeep and additions in physics lab curriculum.

Developed graduate and undergraduate student support programs to provide both academic and technical support and to build towards improving departmental culture.

Undergraduate Student Research Mentor Aug. 2013 - Sept. 2018

University of California, Riverside

Trained six engineering undergraduate students and two visiting summer interns in using various apparatus affiliated with my doctoral research.

Mentored the development of experiments and projects for the students to conduct.

Mentored the students in pursuit of their professional development.

Included three students as co-authors of publications.

Graduate Writing Consultant July 2018 - Sept. 2018

University of California, Riverside

Consulted with graduate students to improve writing in any project they brought in, including dissertations, class papers, fellowship applications, faculty applications, and manuscripts intended for publication.

Co-led a workshop preparing students to write the research statement for NSF Graduate Research Fellowship Program applications.

Undergraduate Seminar Manager Sept. 2015 - Sept. 2018

University of California, Riverside

Co-developed weekly seminar program for interdisciplinary undergraduate and graduate student researchers affiliated with NSF PIRE “Window to the Brain” research grant.

Established and managed journal club program to engage undergraduate students with scientific literature, critical analysis, and communication.

Led fundamental lectures on materials science.

Undergraduate Researcher Placement Sept. 2015 - Sept. 2018

University of California, Riverside

Recruited, interviewed, trained, and placed undergraduate students with various projects affiliated with NSF PIRE "Window to the Brain" research grant. Established a "pool" of trained undergraduates for quick integration into research as needed.

Outreach Program Developer Aug. 2017 - Sept. 2018

University of California, Riverside

Developed and organized outreach programming affiliated with NSF PIRE "Window to the Brain" research grant.

Teaching Assistant

University of California, Riverside

ME 110: Mechanics of Materials Jan. 2015 - March 2015

ME 170B: Experimental Techniques Sept. 2016 - Dec. 2016

"Lawrence University Bomb Squad" Jan. 2009 - June 2012

Lawrence University, Appleton, WI

Participated in volunteer science demonstration show for K-12 students.

Organized meetings, shows, contact with community schools, new events and demonstrations as club president in 2011-2012.

RESEARCH EXPERIENCE:

Current Projects:

(*Pending Award*) Co-PI on NSF Advancing Informal STEM Learning grant with UCR Professors Flip Tanedo (Physics) and Kalina Michalska (Psychology), and with Linda Sherman-Nurick (Proprietor of Cellar Door Books). Responsible for education research design to guide program development and to assess education outcomes.

Project: Refining descriptive framework presented in M.Ed. thesis to understand the origins and propagation of the prevalent anti-diversity culture in physics higher education. Revisions draw on experience as participant-observer in the process of physics higher education and deeper familiarity with physics education research literature canon.

Project: Conducting interviews of junior physics faculty to develop an understanding of what motivates the development of physicists' teaching identities in an R1 institution, where the faculty incentivization structure skews away from prioritizing teaching. Namely, I seek to understand the extent to which individuals' teaching identities are founded in personal ideologies regarding teaching in higher education in comparison with identities performed according to observations of others and perceptions of the discipline.

Academic Coordinator Sept. 2018 - Jan. 2020

University of California, Riverside

Project: As participant-observer, developing theoretical understanding for effectiveness of different methods of soliciting qualitative data seeking to interrogate how different students experience the introductory laboratory activities and associated interactions. Specific objectives that guide judgement include discipline-specific goals, commensurate with those articulated in "AAPT Recommendations for the Undergraduate Physics Laboratory Curriculum" (2014). Objectives also include meta-cognitive and socio-cultural goals like engagement with the process of experimentation, sense of community, identity expression and development, contextual analysis, and critical thinking.

Higher Education Scholar Sept. 2016 - Dec. 2018

University of California, Riverside

M.Ed. Thesis Project: Descriptive framework to enable articulation of inequities pertaining to diverse student populations in physics higher education. The framework underscores the relation between student learning in physics higher education and the cultural context that informs the learning environment through which the education is offered. It unites scholarly work addressing similar issues in other fields with the unique paradigm in physics, and provides guidance for further research to understand the issue through a theoretical lens informed by the core tenets of Critical Race Theory.

Project: Conducted a participant-observation and meta-analysis of the development of an improved introductory physics lab curriculum with the goal of building an engaging and inclusive environment to facilitate goal orientation and physics learning. Intervention points include laboratory curriculum, pedagogical practice by teaching assistants, and culture of trust and validation between students and the education process.

Project: In collaboration with K.L. Whitman, conducted a policy analysis of the 1998 Amendments to the Higher Education Act of 1965 that restricts federal and state financial aid for the education of students previously convicted specifically of drug offenses. The analysis is framed by Critical Race Theory and Critical Race Praxis in Education. Though it has been shown that education significantly reduces the likelihood of recidivism in previously incarcerated individuals, the policy prevents the awarding of financial aid to applicants with prior drug convictions, which have been extensively shown to disproportionally and intentionally target minoritized populations.

Graduate Student Researcher Aug. 2013 - Sept. 2018

University of California, Riverside

Dissertation project: Cu_2ZnSnS_4 (earth-abundant and inexpensive photovoltaic material) nanoparticle synthesis and sintering into large-grain thin films.

- Developed synthesis protocol using aerosol spray pyrolysis.
- Adapted coating and high-temperature annealing in partially evacuated sulfur atmosphere techniques from existing literature.
- Discovered amorphous-oxide "surfactant" process to enhance grain growth and phase uniformity in CZTS thin films.
- **(UG Project: Edgar Palmes & Rui Xu)** Developed Na_2S-solution-dipping technique to easily dope sodium into the material system and enhance grain growth during sulfur-annealing process.
- Built unique *in situ* Raman furnace to study effect of phase segregation and phase evolution on grain growth in thin films during sulfur-annealing process. Observed *in situ* cation-site ordering during thermal processing and also re-homogenization of decomposed material via low temperature secondary anneal.

Project: Plasmonic ZrN (earth-abundant, narrow band visible-light absorber material for localized thermal energy generation) nanoparticle synthesis by non-thermal plasma technique as alternative to plasmonic gold/silver/platinum plasmonic nanostructures.

- Developed unique synthesis protocol using non-thermal plasma technique.
- Refined plasmonic absorption between 520-650 nm, making the material comparable in absorption to gold nanoparticles.
- Explored oxidation kinetics and effect of oxidation on material optical properties.
- Demonstrated first successful application of plasmonic ZrN nanoparticles in proof-of-concept surface enhance Raman spectroscopy of sucrose.

Project: Suppression of oxidation in plasmonic metal-nitride nanoparticles.

- Developed the idea and procedure to overcoat plasmonic ZrN and TiN nanoparticles with silicon in-flight during non-thermal plasma synthesis — the coating acts as an oxygen sink and protects the metastable nitride material while preserving the plasmonic photo-absorption even in harsh oxidative environments.

Project: Synthesis of yttria-stabilized zirconia nanoparticles as part of interdisciplinary and international collaboration to produce a "Window to the Brain" — a cranial implant to allow light-based diagnosis and therapy of brain tissue without repetitive craniotomy.

- **(UG Project: Crystal Mariano)** Developed protocol to synthesize yttria-stabilized zirconia nanoparticles using aerosol spray pyrolysis — controlled the yttria-doping, particle-agglomeration, morphology, size, and crystalline phase to create transparent bulk-sintered disks with low optical scattering.

(UG Project: Crystal Mariano) Studied the cellular toxicity of yttria-stabilized zirconia nanoparticles with different dopant to aid in eventual FDA approval of the implanted device.

In collaboration with C. Rudnicki, developed and refined protocol to sinter yttria-stabilized zirconia nanoparticles produced using aerosol spray pyrolysis into semi-transparent ceramic disks. Conducted optical and mechanical characterization of sintered material to demonstrate viability as cranial implant.

Masters Intern in Software Engineering & Architectures Division Feb. 2013 - Aug. 2013

Pacific Northwest National Laboratory, Richland, WA

Applied Java and C# software languages for development of RFID communication, character recognition, and data-stream managing.

Dale L. Skran, Sr. Undergraduate Research Fellow June 2011 - Aug. 2011

Lawrence University, Appleton, WI

Project: Under advisement of Prof. Matt Stoneking, studied the evolution of electrostatic waves in pure-electron plasma in order to diagnose plasma characteristics.

SCHOLARLY ARTICLES:

1. *(In Preparation)* C. Berrospe Rodriguez, A. Alvarez Barragan, G. Nava, **S. Exarhos**, L. Mangolini. “Refractory plasmonic response in titanium nitride particles stabilized by a silicon nitride shell.”
2. *(In Revision)* **S. Exarhos**. “Anti-Deficit Framing of Physics Education Research.”
3. *(Submitted)* K.L. Whitman, **S. Exarhos**. “A critical analysis of the 1998 amendments to the Higher Education Act of 1965: Racial implications for students convicted of drug felonies.”
4. *(Accepted, Jan. 2020)* C. Rudnicki, **S. Exarhos**, C. Mariano, L. Mangolini. “Spray Pyrolysis of Yttria-Stabilized Zirconia Nanoparticles and their Densification into Bulk Transparent Windows.”
5. D. Rutherford, **S. Exarhos**, C. Xu, M. Niacaris, C. Mariano, B. Daya, L. Mangolini, H. Liu. “Synthesis, characterization, and cytocompatibility of yttria stabilized zirconia nanopowders for creating a window to the brain.” *Journal of Biomedical Materials Research Part B: Applied Biomaterials*, (2019), 1-14.
6. **S. Exarhos**, E. Palmes, L. Mangolini. “Structural homogenization and cation ordering in CZTS films during sulfurization as probed *via in-situ* Raman.” *Thin Solid Films*, **684**, (2019), 21-30.
7. **S. Exarhos**, A. Alvarez Barragan, E. Aytan, A. A. Balandin, L. Mangolini. “Plasmonic Core–Shell Zirconium Nitride–Silicon Oxynitride Nanoparticles.” *ACS Energy Letters*, **3**, (2018), 2349-2356.

8. D. Coleman, T. Lopez, **S. Exarhos**, M. Mecklenburg, S. Bux, L. Mangolini. "Thermoelectric performance of silicon with oxide nanoinclusions." *Materials Research Letters*, **6**(8), (2018), 419-425.
9. **S. Exarhos**. "Compromise to Optimize: Aligning Introductory Physics Education with Administrative Goals in American Higher Education." APS Forum on History of Physics Essay Contest, (2017).
10. **S. Exarhos**, E. Palmes, R. Xu, L. Mangolini. "Amorphous-oxide-induced grain growth in ligand-free CZTS nanoparticle coatings." *RSC Advances*, **7**, (2017), 25575-25581.
11. A. Alvarez Barragan, H. Malekpour, **S. Exarhos**, A.A. Balandin, L. Mangolini. "Grain-to-Grain Compositional Variations and Phase Segregation in Copper-Zinc-Tin-Sulfide Films." *ACS Applied Materials & Interfaces*, **8**(35), (2016), 22971-22976.
12. A. Alvarez Barragan, **S. Exarhos**, L. Mangolini. "Tin Disulfide Segregation on CZTS Films Sulfurized at High Pressure." *Materials Letters*, **165**, (2016), 41-44.
13. **S. Exarhos**, K.N. Bozhilov, L. Mangolini. "Spray Pyrolysis of CZTS nanoplatelets." *Chemical Communications*, **50**(77), (2014), 11366-11369.

PRESENTATIONS:

1. (Oral) AAAS Pacific Division Annual Meeting, June, 2018, "Plasmonic Zirconium Nitride Nanoparticles."
   - **President's Award in Division-Wide Graduate Student Paper Competition**
2. (Oral) MRS Spring Meeting 2018, April, 2018, "Non-Thermal Plasma Synthesis of Plasmonic Zirconium Nitride Nanoparticles and Oxidation Mitigation."
3. (Oral) APS March Meeting 2018, March, 2018, "Non-Thermal Plasma Synthesis of Plasmonic Zirconium Nitride Nanoparticles and Oxidation Mitigation."
4. (Oral) AVS 64th International Symposium and Exhibition, November, 2017, "Phase Stability and Cation Site Distribution During Thermal Annealing of CZTS Nanoparticle Coatings."
5. (Poster) ISPC23, July, 2017, "Non-Thermal Plasma Synthesis of Plasmonic Zirconium Nitride Nanoparticles."
6. (Oral) 44th ICMCTF, April, 2017, "*a*-Oxide-Induced Grain Growth in Ligand-Free CZTS Nanoparticle Coatings."
7. (Oral) TMS 2017, February, 2017, "Effects of oxidation and phase evolution on grain growth in ligand-free CZTS nanoparticles."
8. (Oral) AVS 63rd International Symposium and Exposition, November, 2016, "Oxygen-Induced Sintering of CZTS Nanoparticles."

9. (Poster) MRS Spring Meeting 2016, March, 2016, "Incorporating Silicon into Spray-Pyrolyzed CZTS Nanoparticles and Sintered Thin Films."
10. (Oral) AVS 62nd International Symposium and Exposition, November, 2015, "Composition Control and Doping Uniformity in Spray Pyrolyzed CZTS Nanoparticles and Films."
11. (Invited Oral) UCR Mechanical Engineering Graduate Seminar, June, 2015, "Aerosol Spray Pyrolysis Synthesis of CZTS Nanoparticles for Photovoltaic Applications."
12. (Poster) MRS Spring Meeting, 2015, March, 2015, "Aerosol Spray Pyrolysis Synthesis of CZTS Nanostructures."
13. (Oral) AVS 61st International Symposium and Exposition, November, 2014, "Aerosol Spray Pyrolysis Synthesis and Characterization of CZTS Nanostructures."
14. (Poster) MRS Spring Meeting, 2014, March, 2014, "Aerosol Spray Pyrolysis Synthesis of CZTS Thin Films."
15. (Poster) AVS 59th International Symposium and Exposition, November, 2012, "Diagnosing a Toroidally Confined Pure Electron Plasma Using Electrostatic Waves.

PROFESSIONAL SERVICE:

Invited Panelist:

Readiness and Improvement for Successful Employment: Professional Development Conference for UCR Foster Youth	Feb., 2020
UCR Mechanical Engineering Graduate Student Association "Careers in Teaching and Industry Panel"	May, 2019
UCR Graduate Division "Careers in Higher Education Panel"	May, 2019

Active member:

American Association of Physics Teachers	Nov. 2017 - Present
American Physical Society	Nov. 2017 - Present
Materials Research Society	March 2014 - Present
American Vacuum Society	Oct. 2012 - Aug. 2019

Associate Soccer Coach May 2014 - Aug. 2016

SoCal Rush Soccer Club, Apple Valley, CA

Trained for and achieved USSF National 'D' Coaching License.
Coached boys under 9 team full time.
Trained advanced players in position-specific sessions.
Guest coached for teams of all age groups.

Assistant Varsity Soccer Coach Aug. 2012 - June 2013

Hanford High School, Richland, WA

Coached as assistant for girls' varsity team in fall of 2012.
Coached as co-assistant for boys' varsity team in spring of 2013.

Associate Soccer Coach Nov. 2010 - June 2012

Appleton Soccer Club, Appleton, WI

Coached girls under 7 team full time.
Co-coached youth academy program.

Sports Editor, *The Lawrentian* Jan. 2009 - Jan. 2011

Lawrence University, Appleton, WI

Collected, wrote, edited, and formatted articles and blurbs for weekly school newspaper.

COMMUNITY ENGAGEMENT:

Botanic Garden Volunteer Worker, UCR Botanic Garden, Riverside, CA Feb. 2020 - Present

Volunteer Science Fair Judge, Notre Dame Middle School, Riverside, CA Nov. 2014 - Present

Volunteer Photovoltaic Installer, GRID Alternatives, Riverside, CA Feb. 2014 - July 2018

Bram Bratà Steel Drum Band, Richland, WA June 2005 - Aug. 2008