MORGAN C. CHAMBERLAIN

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EDUCATION

Ph.D. Candidate in Materials Engineering 2020 - Present
Purdue University

Bachelor of Science in Physics 2016 - 2020
Linfield University

Bachelor of Science in Mathematics 2016 - 2020
Linfield University

PUBLICATIONS

Morgan Chamberlain, Justin Miller, Teal Dowd, Jung Soo Rhim, Diana Heflin, Ilke Akturk, Jacob Coffing, and Jan-Anders Mansson. "Development of A Bicycle Crank Arm Demonstrator via Industry 4.0 Principles for Sustainable and Cost-Effective Manufacturing." *Sports Engineering* **26**, 2 (2023) DOI: 10.1007/s12283-022-00394-1

Morgan Chamberlain, Justin Miller, Diana Heflin, Teal Dowd, Jung Soo Rhim, Ilke Akturk, Jacob Coffing, and Jan-Anders Mansson. "Cycling and Sustainability: Development of A Recycled Carbon fiber (rCF) Crankset Demonstrator". *ISEA Engineering of Sport Conference Proceedings.* (June 2022)

Morgan Chamberlain and Alex Reichanadter, Jan-Anders Mansson. "Hot-Melt Prepreg Manufacturing Conditions on Particle Infiltration of Fiber Beds". *Planned submission February 2023*

RESEARCH EXPERIENCE

Graduate Research Assistant, Purdue University 2020 - Present
Advisor: Dr. Jan-Anders Mansson

- Project lead for an interdisciplinary, collaborative project launched in August 2021. Project has developed an aluminum bicycle crankset demonstrator part. Project includes initial part design and CAE, part fabrication, mechanical testing methodology and validation against ISO standards, metrology and dimensional stability analysis, FEA, and a predictive technical cost model of the entire process. This cycle will be repeated for several material systems including metal and polymer composites. The polymer composite design will include mold design and a skeletal composite tow that will by hybrid overmolded. All parts are mechanically tested to realistic in-service load cases that also satisfy ISO performance standards. Presented at the 2022 International Sports Engineering Association's (ISEA) Engineering of Sport 14 Conference, as well as published in *Sports Engineering.*
- Wrote a proposal that was accepted for a Ford-Purdue Alliance project centered on the reliability of recycled automotive-grade composites. The proposed project will replicate the implementation of a closed-loop recycling system within Ford for a demonstrator component by tracking the reliability of three automotive-grade fiber reinforced injection molding materials as they go through multiple cycles of recycling.
- Contributor in a collaborative project with Ford Motor Company, Oak Ridge National Laboratory, and the U.S. Department of Energy . This on-going project aims to develop a new class of recyclable, multi-functional composite materials to produce lightweight smart structures for a new cross-car beam design. Individual contributions have included the production of 300 m of thermoplastic prepreg made out of glass fiber-reinforced polyamide-66, that was then used to manufacture a skeletal backbone for the cross-car beam.
- Conducted research in the manufacturing effects on multi-phase thermoplastic prepreg tape production. Produced Kevlar-reinforced polyamide-66 prepreg and evaluated differences in particle infiltration and fiber bed saturation based on fiber tensioning for both rubber-toughened polyamide-66 and glass bead-reinforced polyamide-66.

NSF Physics REU, University of Washington Summer 2019
Advisor: Dr. Kai-Mei Fu

- Studied hyperfine interactions of nitrogen-vacancy (NV) centers in diamonds samples by utilizing confocal microscopy. Resolved the degeneracy of the NV centers' spin states with optically detected magnetic resonance to identify the nitrogen isotope. Wrote a MATLAB program to externally control the laser and RF pulse sequence to produce Rabi oscillations. Analyzed the fluorescence of the excited NV centers at room temperature.
- Compared results of single NV centers to a photoluminescence excitation (PLE) test, which displays the emission spectra of each NV. This was done with an aim of determining whether implanted or grown NV centers have a higher tendency towards spectral diffusion, reflecting the potential of the ion implantation method for future applications of NV centers as qubits.
- Worked with a team to write the MATLAB program to execute all three experiments (Continuous Wave Optically Detected Magnetic Resonance, Rabi oscillations, and Pulsed Optically Detected Magnetic Resonance) for each NV center on a diamond sample. The program locates an NV center, executes all three tests and identifies the isotope, maps that identification onto a confocal scan of the sample, and then moves on to the next NV center and repeats the process.

Research & Development Intern, Applied Physics Technologies 2017-2019
Advisor: Dr. William Mackie

- Studied field emission and thermionic emission sources for electron microscopes.
- Optimized the electrochemical etching procedure for hafnium carbide emission sources to consistently obtain uniformly etched tips with a radius of 100-200 nm. Published Applied Physics Technologies' Standard Operating Procedure for the improved process.
- Collaborated with Sandia National Laboratories to study the tip faceting effect of hafnium carbide cathodes while under an applied field.
- Utilized ultra-high vacuum systems to measure work functions of lanthanum hexaboride cathodes.

CONFERENCE PRESENTATIONS

Oral Presentations

ISEA Engineering of Sport Conference West Lafayette, IN June 2022

- "Cycling and Sustainability: Bicycle Crank Arm Demonstrator for Sustainable and Cost-Effective Manufacturing"

Conference for Undergraduate Women in Physics (CUWiP) College Park. MD January 2020

- Invited keynote address: "Commissioned Conference Painting: The Impact of Representation in Physics"

Poster Presentations

American Physical Society (APS) March Meeting Denver, CO March 2020

- "Quantum Defects in Diamond: Identifying Nitrogen Isotopes of Nitrogen-Vacancy (NV) Centers"

American Physical Society (APS) March Meeting Boston, MA March 2019

- "Field Electron Emission of Hafnium Carbide"

LEADERSHIP EXPERIENCE

Vice President, Materials Engineering Graduate Student Association (MSEGSA), Purdue University 2022 - Present

Project Lead, Purdue University 2021 - Present

- Lead of a lab-wide project focused on the development of a bicycle crank set, with approximately ten members across several disciplines. Responsibilities include presenting this project at a conference, publishing the results, leading weekly meetings, organizing project workstreams, giving tours to industry visitors, in addition to research contributions such as testing mechanical performance of prototypes to industry standards.

· Fostered a collaboration with Mitsubishi Chemical to incorporate their non-woven recycled carbon fiber mat into future iterations of the polymer composite design. Correspondence with industry collaborators are also developed to identify areas of need in the cycling industry where sustainability and cost-efficiency can be improved using Industry 4.0 manufacturing methodology, including predictive technical cost modeling and predictive maintenance.

President, Society of Physics Students (SPS), Linfield University 2019 - 2020

· Rejuvenated Linfield's SPS chapter by emphasizing interdisciplinary collaboration, community support, and underclassmen involvement.

Co-President, Linfield Math Club, Linfield University 2017 - 2018

· Organized club events with an aim of making mathematics more accessible to a larger community on campus. Collaborated with professors to create an informal environment for students looking to learn more about being a math major. Fostered a community that reaches students of all mathematical backgrounds and skill sets.

EXPERIMENTAL QUALIFICATIONS

Materials Characterization	Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS), X-Ray Diffraction (XRD), Thermogravimetric Analysis (TGA), Brunauer-Emmett-Teller surface area analysis (BET), Polymer rheology
Composites Manufacturing	Thermoplastic prepreg manufacturing, Hybrid injection molding, Re-manufacturing of recycled fibers
Product Development	MATLAB, SolidWorks, MSC Apex, NX, PolyWorks, Metrology
Mechanical Testing	Fatigue testing, Load frame quasi-static testing
Statistical Analysis	Weibull analysis, Mathematica, Lifetime prediction, Reliability analysis

AWARDS & HONORS

Robert M. Briney Achievement Award	Awarded by Purdue University School of Materials Engineering for outstanding PhD preliminary exam performance and potential for research contributions (2022).
Ross Fellowship	Awarded from Purdue University for academic excellence (2020).
Outstanding Senior Award	Awarded by Linfield University's Physics Department (2020).
Pi Mu Epsilon	Member of U.S. Honorary National Mathematics Society (2019).

TEACHING EXPERIENCE

Graduate Teaching Assistant, Purdue University Spring 2022

· Course taught: MSE 335: Materials Characterization Laboratory.

· Instructed five separate lab sections focused on materials characterization fundamentals within metals, ceramics, and polymer material systems.

· Instructed the students on theory and practice of characterization techniques including: sample mounting and polishing, scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), x-ray diffraction (XRD), thermogravimetric analysis (TGA), and Brunauer-Emmett Teller surface area analysis (BET).

Undergraduate Teaching Assistant, Linfield University 2018 - 2020

· Courses taught: PHYS 325: Computational Physics, PHYS 210: Intro to Mechanics, PHYS 211: Intro to E&M

· Worked for three years as an undergraduate TA in the physics department. Responsibilities included laboratory setup and instruction, trouble-shooting equipment, and grading weekly laboratory notebooks.

Physics and Mathematics Tutor, Linfield University 2017 - 2020

· Physics curriculum: PHYS 325: Computational Physics, PHYS 220: Thermal & Statistical Physics, PHYS 215: Modern Physics, PHYS 211: Intro to E&M, PHYS 210: Intro to Mechanics

· Math curriculum: MATH 250: Linear Algebra, MATH 210: Ordinary Differential Equations, MATH 200: Vector Calculus, MATH 175: Calculus II, MATH 170: Calculus I