Zachary Swain
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EDUCATION

University of Delaware, Newark DE

- PhD, Materials Science and Engineering — *June 2019 - Dec. 2024*
- Bachelor of Mechanical Engineering — *Sept. 2015 - June 2019*
  Aerospace Engineering Concentration, Mathematics Minor

EXPERIENCE

Graduate Researcher — *June 2019 - Dec. 2024*

University of Delaware, Materials Science and Engineering, Newark DE

- Inventor of 3 intellectual properties now under patenting process in US and EU
- Selected as inaugural Innovation Delaware Fellow with financial award from US SBA
- Led efforts for $5M grant to accelerate innovation in technology development for translational research
- Lead researcher of NIH clinical trial for haptic materials conducted with human subjects
- Received *Art in Materials 2024* award for Materials Science and Engineering with financial award
- Funding from US Army Research Lab APG, NSF, NIST, DOE CPI EFRC, NIH R01, NIH R21

Research work has included flow calculation and nozzle design for high pressure systems, material interface mechanics for tough parts, composite material design for tunable properties, surface chemistry for dynamic interfaces, wear and fouling mechanisms for durability, mechanical and thermal materials characterization for property analysis, theoretical and computational modeling for material selection and property prediction, material design for human factors, advanced additive manufacturing systems for high performance, and equipment design and prototyping.

This work encompasses research in Materials Science and Engineering conducted for my PhD. The research has generally covered engineering, manufacturing, processing, and analysis of advanced materials for aerospace applications. Out-of-lab activities have included generating proposals for solicitations, planning and executing project efforts, as well as establishing and managing industry partnerships. This work has resulted in several patent applications, peer-reviewed publications, and contract awards. As a senior member of the research group, soft skill work has included oversight of junior member projects, mentorship and management of undergraduate team, and progress reporting.

Cofounder — *May 2023 - Nov. 2024*

Falcon Additive, Wilmington DE

- Advanced additive manufacturing systems for composites, exotic materials, and gradient structures
- Managed team, company operation, licensing, product development, prototyping, and manufacturing
- Demonstrated ability in technology innovation & translation, commercialization strategy, lean deployment, team building & management, orienting strategic objectives, managing industry partnerships

Undergraduate Researcher — *Nov. 2015 - June 2019*

University of Delaware, Materials Science and Engineering, Newark DE

- Managed undergraduate project, process line restructuring, equipment design, prototyping & production
- Investigated mechanical & thermal design, flow modeling, additive manufacturing, polymer processing
- Developed models for generalizable extruder performance and thermorheological melt process

Design Engineer *Aug. 2018 - Dec. 2018*
Johnson & Johnson Consumer Inc, Fort Washington PA
• Contracted design overhaul of fluid bed granulator pneumatic filtration purge system used for pharmaceutical pilot batch processing of actively researched compounds at J&J's R&D facility

Thermal Material Analyst *June 2014 - Aug. 2015*
AKS Technical, Newark DE
• Thermal Protective Performance testing for analysis of textile material systems' thermal transmission and resilience to heat and flame

SKILLS

• Demonstrated ability in technology innovation & translation, commercialization strategy, development / prototyping / production, lean deployment, orienting strategic objectives, team building & management
• Proficient in report & proposal writing, programming (Python, Matlab, Fortran), CAD (slicers, Inventor, Solidworks), simulation (FEA, CFD, FVM), machine design, image analysis, class 100 cleanroom trained
• Materials characterization expertise and training includes mechanical, thermal, viscous, x-ray, infrared, nanoscale microscopy, and failure mode analysis methods.

Materials Characterization

• Mechanical testing	• Thermogravimetric analysis (TGA)	• Differential scanning calorimetry (DSC)
• Capillary & rotational rheology	• Dynamic mechanical analysis (DMA)	• Scanning electron microscopy (SEM)
• Spectroscopic ellipsometry	• Atomic force microscopy (AFM)	• Energy dispersive X-ray spec. (EDX)
• X-ray reflectometry (XRR)	• X-ray photoelectron spec. (XPS)	• Fourier-transform infrared spec. (FTIR)

PUBLICATIONS

• Swain, "Engineering mechanics of static and dynamic material interfaces" In Preparation *Dec. 2024*
• Swain et al. "Self-assembled thin films as alternative surface..." *RSC Materials Chemistry B* *Sept. 2024*
• Nguyen et al. "One pot photomediated ... conductive hydrogels" *ACS Polymers Au* *Oct. 2023*
• "*Positive displacement pump material delivery system...*" U.S. Patent App. 18/131,669 *Aug. 2023*
• Naqi et al. "Dual material fused filament fabrication..." *ACS Applied Polymer Materials* *Feb. 2023*
• Phan et al. "Computational fluid dynamics simulation..." *Additive Manufacturing* *May 2020*
• Edwards et al. "Maximal 3D printing extrusion rates" *IMA Journal of Applied Mathematics* *Oct. 2019*
• Phan et al. "Rheological and heat transfer effects..." *Journal of Rheology* *Sept. 2018*
• Mackay et al. "The performance of the hot end..." *Journal of Rheology* *Mar. 2017*

CONFERENCE PRESENTATION

• *Extrudate instabilities in fused filament fabrication...* Society of Rheology 92nd Annual Meeting *Oct. 2021*

ACTIVITIES

• College of Engineering Leadership & Policy, University of Delaware *Jan. 2023 - Present*
• Adhesion Society - Alexandria, VA *Jan. 2023 - Present*
• NSF Innovation Corps - National Science Foundation, Northeast Region *June 2021 - Present*
• AIAA Member - American Institute of Aeronautics and Astronautics *Jan. 2021 - Present*
• Society of Rheology - American Institute of Physics *Jan. 2017 - Present*
• SAMPE - Society for the Advancement of Material and Process Engineering *Sept. 2016 - Present*
• Intramural Basketball - University of Delaware *Sept. 2015 - Present*

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