

# Mason Zadan

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## EDUCATION

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### Carnegie Mellon University

*Doctor of Philosophy in Mechanical Engineering*  
*Advisor: Carmel Majidi*

*August 2024*  
*Pittsburgh, PA*

**Thesis:** Stretchable Thermoelectric Devices for Wearable Electronics and Soft Robotics

**Relevant Courses:** Principles of Soft-Matter Machines & Electronics, Soft Robots: Mechanics, Design and Modeling, Applied Gadgets, Sensors and Activity Recognition in HCI, Direct Solar and Thermal Energy Conversion

### University of Richmond

*Bachelor of Science in Physics with a Minor in Mathematics*

*May 2020*  
*Richmond, VA*

**Honors:** Magna Cum Laude

**Relevant Courses:** Quantum Mechanics, Electricity and Magnetism, Differential Geometry, Biophysics, Quantum Mechanics, Computational Methods, Classical Mechanics, Statistical Mechanics

## APPOINTMENTS

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### David H. Koch Institute for Integrative Cancer Research at Massachusetts Institute of Technology

*Postdoctoral Research Associate*  
*Mentors: Ana Jaklenec, Robert Langer*

*November 2024-Present*  
*Cambridge, MA*

## PHD RESEARCH EXPERIENCE

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PhD Candidate

*September 2020-August 2024*

- Led research efforts on Air Force funded project with series A startup Ariecca Inc. on developing wearable thermoelectric generators
- Published 12 papers during PhD with additional manuscripts in preparation and under review, including research articles in Nature Materials, Advanced Materials, and Advanced Functional Materials
- Developed three generations of soft and stretchable wearable thermoelectric energy harvesters enabled by liquid metal composite materials
- Introduced thermoelectric Peltier heating and cooling into liquid crystal elastomer shape memory polymers for soft robotic limbs that double as energy harvesters
- Developed first of its kind photoplethysmography (PPG) wearable garment powered solely by body heat

## PREVIOUS RESEARCH EXPERIENCE

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Visiting Researcher Internship

*February 2024-July 2024*

*Materials and Manufacturing Directorate, Air force Research Lab, Dayton, Ohio*

- Collaborated on-site and remotely with AFRL researchers on developing liquid metal MXene nanocomposites
- Conducted microCT testing as well as running data reconstructions on soft composite samples
- Developed and fabricated soft composite materials for thermal and electrical applications

Research Scientist Internship

*May 2023-August 2023*

*Meta Reality Labs, Redmond, Washington*

- Developed wearable hardware solutions for AR and VR applications
- Collaborated with research scientists and managers on researching next generation wearable solutions
- Published work, fabricated samples, conducted testing, and reported results during periodic research updates

Summer Research Fellowship

*July 2019-August 2019*

*Institute of Systems and Robotics, University of Coimbra, Coimbra, Portugal*

- Implemented stretchable thermoelectric generator technology to power temperature and humidity sensor
- Collaborated with Institute of Systems and Robotics researchers to identify implementation strategies and power requirements for various wearable and small electronic devices

Summer Research Fellowship

*May 2019-July 2019*

*Soft Machines Lab, Department of Mechanical Engineering, Carnegie Mellon University*

- Built and characterized first of its kind stretchable liquid metal embedded thermoelectric generator (TEG) energy harvester
- Paper published in ACS Applied Materials & Interfaces and authored conference paper for Behavior and Mechanics of Multifunctional Materials XV

Summer Research Fellowship

May 2018-August 2018

Soft Machines Lab, Department of Mechanical Engineering, Carnegie Mellon University

- Built model to find ideal fill percentages (percolation thresholds) of EGAIn and silver nano-rod embedded elastomer composite materials
- Designed model using a square lattice graph and recursive pathfinding algorithm to compute percolation thresholds for electrical conductivity of composite elastomers

## PUBLICATIONS

**Total Citation Record** – *Google Scholar*: citations = 407, h-index= 6

### Journal Publications

- J. Reese, C.; M. Musgrave, G.; Wong, J.; Pan, W.; Uehlin, J.; **Zadan, M.**; M. Awartani, O.; J. Wallin, T.; Wang, C. Photopatternable, Degradable, and Performant Polyimide Network Substrates for e-Waste Mitigation. *RSC Applied Polymers*, 2024, 2 (5), 805–815.
- **Zadan, M.**; Wertz, A.; Shah, D.; Patel, D. K.; Zu, W.; Han, Y.; Gelorme, J.; Mea, H. J.; Yao, L.; Malakooti, M. H.; Ko, S. H.; Kazem, N.; Majidi, C. Stretchable Thermoelectric Generators for Self-Powered Wearable Health Monitoring. *Advanced Functional Materials*, 2024, 2404861.
- Abdelrahman, M. K.; Wagner, R. J.; Kalairaj, M. S.; **Zadan, M.**; Kim, M. H.; Jang, L. K.; Wang, S.; Javed, M.; Dana, A.; Singh, K. A.; Hargett, S. E.; Gaharwar, A. K.; Majidi, C.; Vernerey, F. J.; Ware, T. H. Material Assembly from Collective Action of Shape-Changing Polymers. *Nature Materials* 2024, 1–9.
- **Zadan, M.**; Patel, D. K.; Sabelhaus, A. P.; Liao, J.; Wertz, A.; Yao, L.; Majidi, C. Liquid Crystal Elastomer with Integrated Soft Thermoelectrics for Shape Memory Actuation and Energy Harvesting. *Advanced Materials* 2022, 34 (23), 2200857.
- Won, P.; Valentine, C. S.; **Zadan, M.**; Pan, C.; Vinciguerra, M.; Patel, D. K.; Ko, S. H.; Walker, L. M.; Majidi, C. 3D Printing of Liquid Metal Embedded Elastomers for Soft Thermal and Electrical Materials. *ACS Appl. Mater. Interfaces* 2022, 14 (49), 55028–55038.
- Roberts, P.; **Zadan, M.**; Majidi, C. Soft Tactile Sensing Skins for Robotics. *Curr Robot Rep* 2021, 2 (3), 343–354.
- **Zadan, M.**; Chiew, C.; Majidi, C.; Malakooti, M. H. Liquid Metal Architectures for Soft and Wearable Energy Harvesting Devices. *Multifunct. Mater.* 2021, 4 (1), 012001.
- **Zadan, M.\***; Malakooti, M. H.\*; Majidi, C. Soft and Stretchable Thermoelectric Generators Enabled by Liquid Metal Elastomer Composites. *ACS Appl. Mater. Interfaces* 2020, 12 (15), 17921–17928.

### Peer-reviewed Conference Proceedings

- Song, Y.; **Zadan, M.**; Misra, K.; Li, Z.; Wang, J.; Majidi, C.; Kumar, S. Navigating Soft Robots through Wireless Heating. In 2023 IEEE International Conference on Robotics and Automation (ICRA); IEEE: London England, 2023; pp 2598–2605.
- Wang, J.; Song, Y.; **Zadan, M.**; Shen, Y.; Chen, V.; Majidi, C.; Kumar, S. Wireless Actuation for Soft Electronics-Free Robots. In Proceedings of the 29th Annual International Conference on Mobile Computing and Networking; ACM: Madrid Spain, 2023; pp 1–16.
- **Zadan, M.**; Patel, D. K.; Malakooti, M. H.; Yao, L.; Majidi, C. Fabrication of 3D Printed Thermoelectric Devices for Integration into Liquid Crystal Elastomer Actuators. In Proceedings of the ASME 2022 Conference on Smart Materials, Adaptive Structures and Intelligent Systems; ASME: Dearborn, Michigan, USA, 2022; Vol. 86274.
- Malakooti, M. H.; **Zadan, M.**; Kazem, N.; Majidi, C. Liquid Metal Composites for Flexible Thermoelectric Energy Harvesting. In Behavior and Mechanics of Multifunctional Materials XV; SPIE: Online, 2021; Vol. 11589, pp 57–64.

### Submitted or Under Review

- Y. Han, V.; Chen, A.; **Zadan, M.**; Gonzalez, J.; K. Patel. D.; Yu, F.; Majidi, C.; Ion, A. Surface-Embedded Smart Flat-Foldable Structures Transform Everyday Objects into Dynamic Entities. ACM CHI conference on Human Factors in Computing Systems 2025, Yokohama, Japan, Under Review.
- Song, Y.; Barambe, A.; K. Patel, D.; Zhuo, B.; **Zadan, M.**; Majidi, C.; Kumar, S. PASTA: Pneumatically Actuated Software-Tunable Antenna. The 31th Annual International Conference on Mobile Computing and Networking; ACM: Hong Kong, China, Under Review.
- Song, Y.; Li, Z.; **Zadan, M.**; Wang, J.; Majidi, C.; Kumar, S. Low-Power Radio-Frequency Actuation for Soft Robots. Advanced Science, Under Review.
- **Zadan, M.**; Hu, Y.; Lipp, J.; Lewis, N.; Shah, D.; F. Islam, M.; Nepal, D.; Grasinger, M.; Dayal, K.; Tabor, C.; Majidi, C. MXene-Coated Liquid Metal Nanodroplets, Nano Letters, Submitted.

## WORKSHOPS AND CONFERENCE PRESENTATIONS

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- **Zadan, M.**; K. Patel, D.; Wertz, A.; Majidi, C. Advances in Soft and Wearable Energy Harvesters Using Stretchable Thermoelectrics. *Materials Research Society Spring Meeting*. April, 2024.
- **Zadan, M.**; Wang, J.; Song, Y.; Patel, D. K.; Li, Z.; Yao, L.; Kumar, S.; Majidi, C. Wireless and Thermoelectric Actuation Methods for Liquid Crystal Elastomer Based Soft Robots. *International Liquid Crystal Elastomer Conference*. October, 2023.
- **Zadan, M.**; Patel, D. K.; Wertz, A.; Shah, D.; Kazem, N.; Majidi, C. Stretchable Thermoelectric Generators and Peltier Coolers for Wearable Applications. *SEMICON West*. July, 2023.
- **Zadan, M.**; Patel, D. K.; Majidi, C. Soft and Stretchable Composite Materials for Wearable Thermoelectric Body Thermoregulation and Energy Harvesting. *39th Annual Semiconductor Thermal Measurement, Modeling and Management Symposium*. March, 2023.
- **Zadan, M.**; Patel, D. K.; Majidi, C. Stretchable 3D Printed Thermoelectric Generators for Liquid Crystal Elastomer Actuation, Control and Energy Recovery. *Materials Research Society Fall Meeting*. December, 2022.
- **Zadan, M.**; Majidi, C. Characterization of Liquid Crystal Elastomer with Integrated Soft Thermoelectrics Enabling Actuation and Energy Harvesting. Workshop on *Determining Appropriate Metrics and Test Methods for Soft Actuators in Robotic Systems*, *International Conference on Robotics and Automation (ICRA)*. May, 2022.

## REVIEWER FOR JOURNALS

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- RSC: Soft Matter Book Series, IOP: Engineering Research Express, IOP: Journal of Physics: Energy, ACS: Energy Letters

## AWARDS AND SCHOLARSHIPS

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### Awards & Honors

- Finalist 2024 CMU Three Minute Thesis Competition
- 3<sup>rd</sup> Place American Society of Mechanical Engineers SMASIS 2022 Conference Best Student Paper Competition
- University of Richmond School of Arts and Sciences Best Paper in the Natural Sciences Award 2020
- The Jackson J. Taylor Best Senior Seminar in Physics Award
- Valedictorian, Eden Christian Academy

### Scholarships and Grants

- Richmond Science Scholar  
Awarded \$200,000 Merit-based full tuition scholarship for four years  
45 Scholars selected from 5,500 applicants

## LEADERSHIP AND TEACHING POSITIONS

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Laboratory Manager

September 2021-March 2024

*Soft Machines Lab, Department of Mechanical Engineering, Carnegie Mellon University*

- Conduct training for over 20 masters, PhD, and postdocs on proper lab protocols and safety practices
- Manage hazardous waste protocols and removal
- Implement and devise lab safety and cleaning procedures
- Manage chemical inventories

Teaching Assistant

Spring 2022, 2023

*Soft Robots: Mechanics, Design and Modeling*

*Instructor: Carmel Majidi*

- Mentored students on a host of soft robotics projects giving design and characterization feedback
- Directed student projects through evaluation of literature reviews and mid-semester and final reports

## **OUTREACH**

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Senior Reviewer

*January 2024-present*

Associate Reviewer

*March 2023-January 2024*

Reviewer

*August 2022-March 2023*

*Journal of Emerging Investigators (JEI)*

- Volunteer at JEI, a non-profit graduate student run open-access journal publishing middle and high school students' research
- Review scientific manuscripts submitted by middle and high school students to mentor, guide, and introduce students to the scientific review process.