Madelyn I. Payne

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Education

University of California – Berkeley Berkeley, CA
Ph.D. candidate in Materials Science and Engineering In Progress
Co-advised by: Prof. Andrew M. Minor and Prof. Mark Asta
with Graduate Certificate in Applied Data Science

Massachusetts Institute of Technology (MIT) Cambridge, MA
B.S. Materials Science and Engineering, GPA: 4.8/5.0 June 2019

Research Interests

I use electron microscopy to understand how multi-principal element alloys deform at various temperature regimes. My work includes both post-mortem microstructure analysis as well as in-situ transmission electron microscopy (TEM) deformation of alloys to understand how various mechanisms work together to produce mechanical properties that are valuable in engineering applications.

Research Experience

PhD Candidate and NDSEG Fellow in MSE Berkeley, CA
Advisors: Prof. Andrew M. Minor and Prof. Mark Asta 2020–Present

- Investigate deformation mechanism in both FCC and BCC high entropy alloys via post-mortem structural analysis and in-situ transmission electron microscopy experiments.
- Develop expertise in advanced materials characterization techniques including transmission electron microscopy (TEM), scanning electron microscopy (SEM), in-situ nanomechanical testing, energy filtering, and 4D-STEM

UROP (Schuh Lab) Cambridge, MA
Undergraduate Researcher

Post-Bac Project: June 2019 – Aug. 2019

- Developed machine learning model in Python to predict copper-based SMA compositions with high crystallographic compatibility
- Cast bulk copper-based SMA tensile bars and performed INSTRON tensile experiments
- Experimented with in rotating water melt-spinning (INROWASP) of iron-manganese SMA wire and investigated the effect of fluid-dynamic levers on the quality of cast product

Senior Thesis: Sep. 2018 – May 2019
Evaluating crystallographic compatibility in polycrystalline copper-based SMAs

- Designed alloys with desired properties, and created alloys through arc melting and induction melting
- Measured alloy transformation temperatures, composition, crystal lattice dimensions with respect to temperature, and functional fatigue with respect to cyclic tensile testing.

UROP Project: Feb. 2017 – Jan. 2018

Mesoscale Computational Modeling of Metallic Glass and Shape-memory Ceramics to understand the microstructure that produces shape-memory properties

- Programmed a kinetics model for the SMA phase transformation in C++ and implemented new speed-up strategies in the execution step of the finite element method

UROP (Personal Robotics Group in the Media Lab at MIT) Cambridge, MA

Undergraduate Researcher June 2016 – Feb. 2017

- Developed Python code to assess the difficulties of children's books based on syntactic and lexical difficulties
- Collected data on how child participants tasked with solving puzzles are affected by a fixed mindset or growth mindset robot companion

Publications

1. Liu, D., Yu, Q., Kabra, S., Jiang, M., Forna-Kreutzer, P., Zhang, R., **Payne, M**., Walsh, F., Gludovatz, B., Asta, M., Minor, A. M., George, E. P., & Ritchie, R. O. (2022). "Exceptional fracture toughness of CrCoNi-based medium- and high-entropy alloys at 20 kelvin", Science, 378(6623), 978–983. https://doi.org/10.1126/SCIENCE.ABP8070
2. Zhang, M., Yu, Q., Frey, C., Walsh, F., Payne, M. I., Kumar, P., Liu, D., Pollock, T. M., Asta, M. D., Ritchie, R. O., & Minor, A. M. (2022). "Determination of peak ordering in the CrCoNi medium-entropy alloy via nanoindentation", Acta Materialia, 241. https://doi.org/10.1016/j.actamat.2022.118380

Works in Progress

1. Kumar, P., Gou, X., Cook, D.H., Morrison, N.J., **Payne, M.I.,** Wang, W., Zhang M., Asta, M., Minor, A.M., Cao, R., Li, Y., & Ritchie, R.O., "On the fracture resistance of NbMoTaW refractory high entropy alloy with nanoscale metal oxide layer on the grain boundaries", (in preparation)
2. Cook, D.H., Kumar, P., **Payne, M.I**., Belcher, C.H., Borges, P., Wang, W., Walsh, F., Li, Z., Devaraj, A., Zhang M., Asta, M., Minor, A.M., Lavernia E.J., Apelian, D., & Ritchie, R.O. "Kink bands enable unprecedented fracture resistance in a refractory medium-entropy alloy from cryogenic to high temperatures", (in review)

Professional Presentations

- **M.I. Payne** et al. **"**Transmission Electron Microscopy of Temperature Dependent Deformation Mechanisms in High-Entropy Alloys", Poster presented at 2023 MRS Spring Annual Meeting and 2023 TMS Spring Annual Meeting
- **M.I. Payne** et al. "In-situ TEM deformation of high entropy alloys", Poster presented at Microscopy & Microanalysis (M&M) Annual Conference (2023)
- **M.I. Payne** et al. "In-situ TEM deformation of CrCoNi Medium Entropy Alloys", Poster presented at MRS Fall 2023
- **M.I. Payne** et al. "In-situ TEM deformation of High Entropy Alloys Across Multiple Temperature Regimes", Oral Presentation at 2024 TMS Spring Annual Meeting

Honors and Awards

- Best Poster Presentation Award for Symposium SF01 2023
  (High Entropy Materials – From Fundamentals to Potential Applications)
  2023 MRS Spring
- National Defense Science and Engineering Graduate (NDSEG) Fellow 2022
  Winner (3 years, $133,000)
- College of Engineering/ Materials Science and Engineering Fellowship 2020
  (2 semesters, $70,253)
- Carl Storm Underrepresented Minority (CSURM) Fellowship ($1000) 2024
- Conference Travel Grant, UC Berkeley ($1,500), 2024

Outreach and Professional Development

Service and Outreach

Anti-Racist Reading Group Facilitator Berkeley, CA
- Lead discussions on various books, movies, and podcasts related to racism, anti-blackness, and systematic oppression with members of the MSE Department — Aug. 2020 – Present

MSE Graduate Student Council Berkeley, CA
Social Chair Aug. 2021 – May 2022
Organize social events for graduate students in MSE Department
Graduate Assembly Delegate Aug. 2023 - Present
Represent the MSE department in the Graduate Assembly governing body and serve on the Equity and Inclusion Committee

Be A Scientist - *Volunteer scientist mentor* Berkeley, CA
- guide 4-6 7th graders through the process of developing a testable question, designing an appropriate experiment, and gathering and analyzing data — Mar. 2021 – May 2021

MSE New Graduate Student Orientation Committee Berkeley, CA
Committee Member- Organize Orientation for new graduate students Aug. 2021

ReachOut Volunteering Cambridge, MA
East End House Tutor Sep. 2015 – May 2016
- Helped groups of around 20 elementary school students with homework and reading twice a week

Development

Path to the Professoriate Program Berkeley, CA
- Program for first-year PhD students from underrepresented backgrounds to build a personal path to the professoriate; Awarded stipend for completion of deliverables — Dec. 2020 – May 2021

Professional Experience

ATI (Allegheny Technologies Incorporated) Pittsburgh, PA
Engineer I, Early Career Leadership Program Sep. 2019 – July 2020

ATI Flat Rolled Products - Process Automation
- Understand existing melt-shop procedures and melt models for incorporation of process automation improvements in the Latrobe and Brackenridge Operations

Kinalco Cambridge, MA
Engineering Intern June 2019 – Aug. 2019
- Identified composition, transformation temperatures, and functional properties of shape-memory alloy (SMA) ingots, wire, and ribbon
- Investigated how melting conditions affected alloy composition and uniformity

MultiMechanics Omaha, NE
Engineering Intern June 2018 – Aug. 2018
- Validated Finite Element (FE) solutions for elastic indentation models
- Developed Python scripts to post-process stress data from MultiMech (FE) simulations to aid solution validation

Teaching/Mentoring

Research Mentor for the NSF STROBE Summer Undergraduate Program Berkeley, CA
- Guide an undergraduate student through a summer research project, providing technical training and mentorship. Summer 2023

Strobe Mentor Training Workshop Berkeley, CA
- Mentoring training program designed and written by the Center for the Improvement of Mentored Experiences in Research (CIMER) based at UW Madison Summer 2023

Teaching of Mechanical Engineering at the University Level Pedagogy Course Spring 2022
Teaching Conference for First-Time GSI's Spring 2022
3.032x Online TA Cambridge, MA
- Moderated and answered student questions on the online forum for the EdX class 3.032x on Mechanical Properties of Materials Fall 2018

3.094 TA Cambridge, MA
- Guided students through hands-on laboratories including constructing traditional Andean furnaces from the raw materials of clay, slate, and sand Spring 2019

Skills

Programming Languages: Python, Wolfram Language, Java, C++
Material Characterization Techniques: TEM, SEM, DSC, EDXS, XRD, DMA
Finite Element (FE) Software: Gmsh, ANSYS, ABAQUS
Languages: English (Fluent), Spanish (Conversational)