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

Visiting Researcher Thun, Switzerland
at Swiss Federal Laboratories for Materials Science and Technology (EMPA) Summer 2024

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. Kumar, P., Cook, D.H., **Payne, M**., Borges, P.P.P.O., Wang, W., Minor, A.M., Asta, M., & Ritchie, R.O. "Fracture behavior of high-entropy alloys: Resistance to fracture from strain hardening and softening", Matter, 8, 102042 (2025), https://doi.org/10.1016/j.matt.2025.102042.
2. Kumar, P., Gou, X., Cook, D.H., **Payne, M.I.,** Morrison, N.J., Wang, W., Zhang M., Asta, M., Minor, A.M., Cao, R., Li, Y., & Ritchie, R.O. (2024). "Degradation of the mechanical properties of NbMoTaW refractory high-entropy alloy in tension", Acta Materialia, https://doi.org/10.1016/j.actamat.2024.120297.
3. 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 promote exceptional fracture resistance in a NbTaTiHf refractory medium-entropy alloy", *Science,* **384**,178-184(2024). DOI:10.1126/science.adn2428
4. 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. DOI:10.1126/science.abp8070
5. 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

***co-first authorship**

Works in Progress

1. **Payne, M.I.,** In-situ TEM deformation of CrCoNi Medium Entropy Alloys" (in preparation)

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
- **M.I. Payne** et al. "In-situ TEM deformation of High Entropy Alloys Across Multiple Temperature Regimes", Oral Presentation at 2024 NDSEG conference
- **M.I. Payne** et al. "Transmission electron microscopy characterization of deformation features in refractory high entropy alloys", Platform Presentation at Microscopy & Microanalysis (M&M) Annual Conference (2024)
- **M.I. Payne** et al. "Transmission electron microscopy characterization of deformation features in refractory high entropy alloys", Oral Presentation at 2025 TMS Annual Meeting
- **M.I. Payne** "A practical course for first-year PhD students conducting characterization of deformation in structural materials using Universal Design for Learning (UDL) principles", Poster Presentation at the 14th North American Materials Education Symposium (2025)

Honors and Awards

- H2H8 Graduate Research Grant Recipient ($10,000), Hearts to Humanity Eternal 2024
- Carl Storm Underrepresented Minority (CSURM) Fellowship ($1000) 2024
- Conference Travel Grant, UC Berkeley ($1,500) 2024
- 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)

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

Graduate Assembly Delegate Aug. 2023 – Present

- Represent the MSE department in the Graduate Assembly governing body and serve on the Equity and Inclusion Committee

Graduate Council Representative Aug. 2024 – Present

- Student representative on Graduate Council Academic Senate committee. The Academic Senate is the embodiment of shared governance at the University of California. It is unique among faculty senates in its authority, and the respect it commands.

Microscopy Society of America (MSA)

Student Council Regional Liaison 2023-2024

- Organized regional conference for student and post-doc research presentations with 17 speakers and over 50 attendees

MSE Graduate Student Council Berkeley, CA

Social Chair Aug. 2021 – May 2022

Organize social events for graduate students in MSE Department

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

NextProf Nexus 2025: Preparing the next generation of scientific and Academic leaders Berkeley, CA Sep. 8-11, 2025

- Workshop on preparing for the academic job market and building a successful research program

Preparing Future Faculty: Designing Courses through the Lens of Universal Design for Learning (UDL) Working Group Berkeley, CA June 17 – July 26, 2024

- Designed a course through the lens of UDL in a 6 week working group
- Upon completion will receive a certificate in Designing Courses through UDL Awarded stipend for completion of deliverables

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 Societies

- The Microscopy Society of America (MSA)
- The Microanalysis Society (MAS)
- The Minerals, Metals & Materials Society (TMS)
- The Materials Research Society (MRS)

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

Graduate Student Instructor MSE 45 (Properties of Materials) Berkeley, CA
- Instruct students on the basic principles of physics and chemistry to the engineering properties of materials and guide materials science laboratories — Fall 2025

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. — 2023, 2025

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

Graduate Student Instructor MSE 104L (Materials Characterization Lab) Berkeley, CA
- Organized a poster session, designed lab lectures, and taught labs about materials characterization to ~90 undergraduate/graduate students.

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 Materials in Human Experience 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)