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Education

Massachusetts Institute of Technology (MIT) Sep 2017 – May 2023
PhD, Physical Materials Chemistry
NSF Graduate Research Fellowship
Thesis Title: Elucidating Structure-Property Relationships for Targeted Materials Mechanical Design

University of California, Los Angeles (UCLA) Sep 2013 – Jun 2017
BS, Materials Science and Engineering – GPA 3.9/4.0
UCLA Engineering Achievement Award for Student Welfare

Research Experience

MIT, Laboratory for Atomistic and Molecular Mechanics - NSF Graduate Research Fellow, PhD Candidate Dec 2019 – May 2023
- Leverage AI, atomistic simulations, and experiment for understanding material structure-property relationships
- Probe and predict material properties via molecular dynamics simulation and machine learning surrogate models
- Devise AI workflows for generative design of new materials with specified target behavior

MIT, Department of Materials Science and Engineering - Graduate Student Researcher Dec 2017 – Dec 2019
- Design and synthesis of small amphiphilic molecule platform for self-assembly into robust hierarchical materials
- Molecular, nanoscale, and mesoscale characterization of chemical structures, nanoribbons, and centimeter-long assemblies

UCLA, Department of Materials Science and Engineering - Undergraduate Student Researcher Jan 2016 – Jun 2017
- Synthesis of iron oxide nanoparticles for application in magnetic hyperthermia drug delivery
- Nanoparticle characterization and incorporation into drug delivery system

Publications

- **Lew, A.J.**, Stifler, C.A., Cantamessa, A., Tits, A., Ruffoni, D., Gilbert, P.U.P.A., Buehler, M.J. Deep learning virtual indenter maps nanoscale hardness rapidly and non-destructively, revealing mechanism and enhancing bioinspired design. *Matter* (2023). https://doi.org/10.1016/j.matt.2023.03.031
- **Lew, A.J.**, Stifler, C.A., Tits, A., Schmidt, C.A., Scholl, A., Cantamessa, A., Müller, L., Delaunois, Y., Compère, P., Ruffoni, D., Buehler, M.J., Gilbert, P.U.P.A. A molecular scale understanding of misorientation toughening in corals and seashells. *Advanced Materials* (2023). https://doi.org/10.1002/adma.202300373 – **University of Liège News Feature**
- **Lew, A.J.**, Buehler, M.J. Single-shot forward and inverse hierarchical architected materials design for nonlinear mechanical properties using an attention-diffusion model. *Materials Today* (2023). https://doi.org/10.1016/j.mattod.2023.03.007
- **Lew, A.J.**, Jin, K., Buehler, M.J Designing architected materials for mechanical compression via simulation, deep learning, and experimentation. *npj Computational Materials.* 9, 80 (2023). https://doi.org/10.1038/s41524-023-01036-1
- Ni, B., Steinbach, D., Yang, Z., **Lew, A.J.**, Zhang, B., Fang, Q., Buehler, M.J., Lou, J. Fracture at the two-dimensional limit. *Materials Research Society Bulletin.* 47 (2022). https://doi.org/10.1557/s43577-022-00385-4
- **Lew, A.J.**, Beniash, E., Gilbert, P.U.P.A., Buehler, M.J. Role of the mineral in the self-healing of cracks in human enamel. *ACS Nano.* 16, 7, 10273–10280 (2022). https://doi.org/10.1021/acsnano.1c10407
- **Lew, A.J.**, Buehler, M.J. DeepBuckle: Extracting physical behavior directly from empirical observation for a material agnostic approach to analyze and predict buckling. *Journal of the Mechanics and Physics of Solids.* 164, 104909 (2022). https://doi.org/10.1016/j.jmps.2022.104909 – **Patent Application**
- **Lew, A.J.**, Buehler, M.J. A deep learning augmented genetic algorithm approach to polycrystalline 2D material fracture discovery and design. *Applied Physics Reviews.* 8, 041414 (2021). https://doi.org/10.1063/5.0057162 – **Featured Article**
- **Lew, A.J.**, Buehler, M.J. Encoding and exploring latent design space of optimal material structures via a VAE-LSTM model. *Forces in Mechanics.* 5, 100054 (2021). https://doi.org/10.1016/j.finmec.2021.100054
- **Lew, A.J.**, Yu, CH., Hsu, YC., Buehler M.J. Deep learning model to predict fracture mechanisms of graphene. *npj 2D Materials Applications.* 5, 48 (2021). https://doi.org/10.1038/s41699-021-00228-x – **MIT News Feature**
- **Lew, A.J.**, Kaser, S.J., Kim, DY, Christoff-Tempesta, T., Cho, Y., Ortony, J.H. Effects of molecular flexibility and head group repulsion on aramid amphiphile self-assembly. *Molecular Systems Design & Engineering.* 6, 1016-1024 (2021). https://doi.org/10.1039/D1ME00120E
- Christoff-Tempesta, T., Cho, Y., Kim, DY. Geri, M., Guillaume, L., **Lew, A.J.**, Zuo, X., Lindemann, W.R., Ortony, J.H. Self-assembly of aramid amphiphiles into ultra-stable nanoribbons and aligned nanoribbon threads. *Nature Nanotechnology.* 16, 447–454 (2021). https://doi.org/10.1038/s41565-020-00840-w – **Patent Application**
- **Lew, A.J.**, Christoff-Tempesta, T., Ortony, J.H. Beyond covalent crosslinks: Applications of supramolecular gels. *Gels.* 4, 40 (2018). https://doi.org/10.3390/gels4020040

Patents ----------

- **Lew, A.J.**, Buehler, M.J. A Method to Extract Physical Behavior Directly from Simple Visual Empirical Observation Via a Deep Learning Model. *U.S. Provisional Patent Application No. 63/333493.* Filed April 21, 2022.
- Ortony, J., Jia, T., Kim, D. Y., Lindemann, W., Christoff-Tempesta, T., **Lew, A.J.**, & Cho, Y. Aramid amphiphile self-assembled nanostructures. *U.S. Patent Application No. 16/825724.* Filed September 24, 2020.

Industry Experience ----------

C3 AI – Senior Director, Strategic Solutions Jan 2023 – Present

- Consult with external clients up to C-suite level to identify AI-addressable problems
- Scope solution approaches for value-driven enterprise-level AI applications
- Coordinate internal solutions, sales, strategy, and legal teams to serve client digital transformation

Boston Consulting Group – Bridge to BCG Program Member Mar 2022 – Apr 2022

- Strategized while solving a case in a realistic BCG case team simulation
- Teamed with Bridge participants and consultants to understand the why and how behind case work
- Networked with BCG consulting staff and advanced to final round interviews

Patagonia – Case Competition Consultant Jan 2020 – Jul 2020

- Collaborated in multidisciplinary team of 6 engineering, business, and science students to reduce Patagonia's textile waste
- Developed and presented solution to a worldwide audience of Patagonia staff, C-suite, and invited guests
- Won 1st place of 130+ teams, awarded $15,000 and discussions with Patagonia for plans on implementing our solution

Northrop Grumman – Technical Engineer Intern Jun 2016 – Sep 2016

- Supported government DARPA "DAHI" program, "NGnext" nanoparticle research, and polymer coating R&D
- Stewarded newly obtained Laser Scanning Confocal Microscope – tool setup, vendor point of contact, trained other engineers
- Attained Department of Defense Secret-level Security Clearance for trusted projects

Northrop Grumman – Process Integration Intern Jun 2015 – Sep 2015

- Created Excel VBA tools for metric tracking and process flow management
- Investigated correlations between physical properties, processing conditions, and final yields of semiconductor boules
- Evaluated and streamline inspection steps for better process flow

Northrop Grumman – Process Engineer Intern Jun 2014 – Sep 2014

- Led optimization study for development of new GaN dicing processes
- Qualified new automatic tools for more efficient InP dicing processes, saving $50,000/year
- Identified and analyzed defects for hundreds of semiconductor chips

Leadership Experience ----------

MIT CEE GradCom – Graduate Student Leader Jan 2022 – Dec 2022

- Organized department-wide events to reforge student culture after pandemic isolation
- Informed and welcomed newly admitted students at department open houses
- Hosted town halls to gauge student sentiment of the graduate program

MIT ChemREFS – Peer Mentor Mar 2019 – Dec 2022

- Mediated confidential 1-on-1 meetings with students to work through their interpersonal conflicts and graduate school stresses
- Advocated for chemistry graduate students through annual Department Chair meetings
- Outreach to local high schools to present chemistry demos and inspire students to pursue STEM

MIT Chemistry Department – Teaching Assistant Aug 2017 – Dec 2018

- Taught two hour-long sections and held two+ sessions of office hours per week for Course 5.111: Principles of Chemical Science
- Created homework questions, maintained code for online "MITx" portion of the class, tech support for in-person lectures
- Administrative grading and solution key write-up for Course 5.73: Intro to Quantum Mechanics I

Materials Research Society @ UCLA – President May 2016 – Jun 2017

- Led student board of 14 to restructure MRS@UCLA as a consistently active, officially registered student organization
- Organized events including professional workshops, industry info sessions, and mixers between grad/undergrad students
- Collated student feedback on program in department-wide Town Hall meeting, and advocated results to Department Head

SAMPE Bridge Competition Team – Co-Founder, Team Lead, and Mentor Dec 2015 – May 2017

- Restarted UCLA involvement in SAMPE competition with a team of 4 others, petitioned department for lab space and resources
- Led student teams in the design, fabrication, and 3-pt bend testing of glass fiber composite beams
- Developed and taught composite processing workshops to facilitate wider participation in SAMPE Bridge Competition.

Presentations ----------

- **Lew, A.J.** "Elucidating Structure-Property Relationships for Targeted Materials Mechanical Design". *MIT Public Thesis Defense, Cambridge* (2022)
- **Lew, A.J.**, Buehler, M.J. Talk #2011619: "Leveraging Deep Learning Models to Expedite and Expand the Exploration of Material Structures for Mechanical Design". *10th International Conference on Multiscale Materials Modeling, Baltimore* (2022)
- **Lew, A.J.**, Gilbert, P.U.P.A., Buehler, M.J. Poster #SF12.11.06: "Non-destructive Hardness Prediction via Deep Learning Image Regression Models". *MRS Spring Meeting and Exhibit, Virtual* (2022) – **Outstanding Contribution**
- **Lew, A.J.**, Buehler, M.J. Talk #DS03.03.04: "A Deep Learning Augmented Genetic Algorithm Approach for 2D Fracture Discovery and Design". *MRS Fall Meeting and Exhibit, Boston* (2021)
- **Lew, A.J.**, Buehler, M.J. Talk: "Cutting Through Failure by Traversing Across Disciplines: Leveraging Traditional Mechanics, Deep Learning, and Genetic Algorithms to Predict Fracture and Design Material Structure". *MIT Chemistry Student Seminar, Cambridge* (2021)
- **Lew, A.J.**, Buehler, M.J. Talk #21721056: "Using Deep Learning to Predict Fracture: Analysis, Design, and Additive Manufacturing". *16th US National Congress on Computational Mechanics, Virtual* (2021) – **Keynote Address**
- **Lew, A.J.**, Kim, DY, Ortony, J.H. Poster: "From Molecules to Macroscale: Self-assembly of Robust Hierarchically Ordered Materials". *MIT WIC/CADI Poster Symposium, Cambridge* (2019)
- **Lew, A.J.**, Machness, A., Goorsky, M. Poster #557: "Synthesis and Characterization of Superparamagnetic Iron Oxide Nanoparticles for Magnetic Hyperthermia Applications". *UCLA Undergraduate Research Week, Los Angeles* (2017) – **Vice Provost's Poster Recognition Award**
- **Lew, A.J.**, Lieng, J., Tran, V., Wolfman, J. Poster Category D: "I Beam Glass Fiber". *SAMPE Conference and Exhibition, Seattle* (2017)
- Lang, A., Cruz, A., Reyes, A., **Lew, A.J.**, Sulian, A., Lara, A., Del Signore, C., Kotcherha, C., Webber, D., Babiker, H., Wu, J., Cho, K., Matsui, K., Johnson, L., Conde, L., Gutierrez, N., Saepoo, S., Slavin, S., Akiyama, T. Poster: "Microelectronics: Micro-design, Mega-impact". *Northrop Grumman Intern Showcase: Explore Space, Redondo Beach* (2016) – **Best Overall Presentation Award**
- **Lew, A.J.**, Timmons, J., Lieng, J., Figueroa, J., Chu, K. Poster Category E: "Square Beam Glass Fiber", *SAMPE Conference and Exhibition, Long Beach* (2016)
- **Lew, A.J.**, Machness, A., Goorsky, M. Poster #42: "Synthesis and Characterization of Superparamagnetic Iron Oxide Nanoparticles with Varying Precursor Addition Rate". *ACS Southern California Undergraduate Research Conference, Long Beach* (2016) – **Outstanding Poster Award**

Skills ----------

Computational Modeling

- *General* – Python (PyTorch, TensorFlow, Keras, Scikit-Learn, NumPy, Matplotlib, Pandas, Jupyter), RDKit, MATLAB, HTML, Bash
- *Classical Simulation* – Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS), Open Visualization Tool (OVITO)
- *Artificial Intelligence* – Transformer Model, Graph Attention Network, Graph Convolutional Network, Convolutional Neural Network, Residual Neural Network, Long Short-Term Memory Network, Generative Adversarial Network, Variational Autoencoder, Genetic Algorithm, Bayesian Optimization, Supervised Learning, Unsupervised Learning

Laboratory Techniques

- *Organic Synthesis* – Peptide Coupling, BOC-protection/deprotection, Column Chromatography
- *Characterization* – Nuclear Magnetic Resonance (H^1NMR & C^{13}NMR), Thin Layer Chromatography (TLC), Mass Spectrometry (MS), UV-Visible Spectrophotometry (UV-Vis), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), X-Ray Diffraction (XRD), Förster Resonance Energy Transfer (FRET)

Interpersonal Qualifications

- *Mentorship* – Classroom Teaching, 1-on-1 Tutoring, Hands-on Workshops, Teaching Assistant
- *Business* – Miller Heiman Strategic and Conceptual Sales Certification, C3 AI Application Development Methodology Certification
- *Discretion* – Attained Department of Defense Secret-level Security Clearance, Confidential Conflict Mediation Training Certification