Elliot MacKrell

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Education

California Institute of Technology   Pasadena, CA
Ph.D. Chemical Engineering   2016-Present
Thesis Committee: David A. Tirrell, Dianne K. Newman, Mikhail Shapiro, Rustem Ismagilov (Chair)

University of Florida   Gainesville, FL
B.S. Chemical Engineering   2016
Minor: Biomolecular Engineering

Research Experience

California Institute of Technology, Division of Chemistry and Chemical Engineering   2016-Present
NSF Graduate Fellow; Advisor: Prof. David A. Tirrell

- Engineered the degradation of a mutant methionyl-tRNA synthetase to establish a method for time-resolved proteomic analysis of transient physiological states in *E. coli*.
- Identified 152 novel endogenous protease substrates in growing and growth-arrested *E. coli* cells by establishing a quantitative proteomic screen.
- Discovered global regulatory roles of proteolysis by combining linear modeling, independent component analysis, customized bioinformatic searches against the EcoCyc database, and ontological and regulatory network enrichment.

Graduate Rotation Student; Advisor: Prof. Frances H. Arnold

- Expanded the substrate scope of the *P. furiosus* tryptophan synthase β-subunit by assisting in the construction and screening of a directed evolution-based library.

EMD Serono, Department of Translational Medicine and Global Clinical Development   2022
Bioinformatics Co-op; Supervisor: Dr. Irina Kalatskaya

- Developed Shiny application for visualizing cell type-specific gene expression, identifying differentially expressed genes across cell types and disease states, and conducting gene set enrichment in real time.
- Established the semantic association of text-mined ontology terms in PubMed publications through information-theoretic and statistical approaches.
- Developed Shiny application for the real-time analysis of text mining data from PubMed to identify genes, pathways, and diseases associated with EMD Serono queries.

Harvard Medical School, Wellman Center for Photomedicine, Massachusetts General Hospital 2015
NSF REU Fellow; Advisor: Prof. Robert Redmond

- Investigated the effects of photocrosslinking on ex vivo tissue biomechanics via cyclic uniaxial tensile testing.

Johns Hopkins University School of Medicine, Department of Radiation Oncology   2014
NSF REU Fellow; Advisor: Prof. Robert Ivkov

- Evaluated the anti-tumor immune response generated by magnetic nanoparticle hyperthermia and ionizing radiation treatments in a mouse model for cancer.

University of Florida, Department of Chemistry   2012-2015
Undergraduate Research Assistant; Advisor: Prof. Brent S. Sumerlin

- Developed an amphiphilic and pH-responsive copolymer for phloem-specific drug delivery in plants by functionalizing polysuccinimide (PSI) with various hydrophilic molecules.

Publications

Jones, J.J., **MacKrell, E.J.**, Wang, T.Y., Lomenick, B., Roukes, L.M., and Chou, T.F. "tidyproteomics: An open-source R package and data object for quantitative proteomics post analysis and visualization." **BMC Bioinformatics, 2023,** *24,* 239. https://doi.org/10.1186/s12859-023-05360-7

Hill, M.R., **MacKrell, E.J.**, Forsthoefel, C.P., Jensen, S., Chen, M., Moore, G., He, Z.L. and Sumerlin, B.S. "Biodegradable and pH-Responsive Nanoparticles Designed for Site-Specific Delivery in Agriculture." **Biomacromolecules**, **2015**, *16*, 1276-1282. https://doi.org/10.1021/acs.biomac.5b00069

Awards and Honors

Center for Environmental Microbial Interactions (CEMI) Pilot Grant, California Institute of Technology	2018
CEMI Fellow, California Institute of Technology	2016-
NSF Graduate Research Fellowship, California Institute of Technology	2016-2021
Yao Su Student Research Prize, HST Summer Institute	2015
NSF REU Fellowship, Harvard-MIT Division of Health Sciences and Technology (HST)	2015
Collins Engineering Scholarship, University of Florida	2015
NSF REU Fellowship, Johns Hopkins University Institute for NanoBioTechnology (INBT)	2014
University Scholars Program, University of Florida	2013

Presentations

MacKrell, E.J., Sweredoski, M.J., Moradian, A., Garbos, S.D., Tirrell, D.A. "Engineered Protein Degradation for Time-Resolved Proteomics in Bacteria." Poster presentation delivered at ASM Microbe, San Francisco, CA, June 2019.

Liu, X., **MacKrell, E.J**., Tirrell, D.A. "Selective Protein Labeling of Nutrient-Limited Cells in Heterogeneous Biofilms with Bio-Orthogonal Non-Canonical Amino Acid Tagging (BONCAT)" Poster presentation delivered at the Institute for Collaborative Biotechnologies Summer Meeting, Santa Barbara, CA, July 2017.

MacKrell, E.J., McCormack, M., Goldstone, R. and Redmond, R. "Effects of Photocrosslinking on Tissue Biomechanics." Poster presentation delivered at the Harvard-MGH Summer Institute Presentations, Cambridge, MA, August 2015.

Hill, M.R., **MacKrell, E.J.**, Forsthoefel, C.P., Jensen, S., Moore, G., He, Z.L. and Sumerlin, B.S. "Biodegradable and pH-Responsive Nanoparticles Designed for Site-Specific Delivery in Agriculture." Poster presentation delivered at the AIChE Annual Student Conference, Atlanta, GA, November 2014.

MacKrell, E.J., Attaluri, A.C., Zhou, H., Hedayati, M. and Ivkov, R. "Immunomodulation via Nanoparticle-Mediated Hyperthermia and Ionizing Radiation to Enhance Resistance against Distal Tumors." Oral presentation delivered at the Johns Hopkins University Nano-Bio Symposium, Baltimore, MD, August 2014.

Hill, M.R., **MacKrell, E.J.** and Sumerlin, B.S. "pH-Responsive and Biodegradable Nanoparticles Capable of Loading and Releasing Small-Molecule Cargo." Poster presentation delivered at the Florida Undergraduate Research Conference, Miami, FL, February 2014.

Skills and Coursework

Computational skills: Bioinformatic and statistical analysis of mass spectrometry-based proteomics data, Text mining, Machine learning, Shiny application development, Linear modeling, Regulatory network analysis, Gene set enrichment, Modeling and parameter estimation through Bayesian inference and maximum likelihood estimation, Stochastic simulation of biochemical systems

Software environments: Python (Pandas, NumPy, Scikit-learn, Matplotlib, Bokeh, Altair, Seaborn, Jupyter Notebook), R (Shiny, Bioconductor, Clarivate CBDD, RStudio), ImageJ, Mathematica, GeneData Profiler, Visual Studio Code, Git, LaTeX,

Proteomics analysis suites (MaxQuant, ProteomeDiscoverer, Cytoscape, STRING, Perseus with SILAC and TMT quantitation and normalization)

Relevant elective coursework: CS155: Machine Learning & Data Mining, CS156a: Learning Systems, Bi/BE103: Data Analysis in the Biological Sciences, Bi/BE/CS 183: Introduction to Computational Biology and Bioinformatics, ChE/BE 163: Biomolecular Engineering, BE 150: Design Principles of Genetic Circuits, APh 161: Physical Biology of the Cell

Teaching Experience

California Institute of Technology

-	**Undergraduate Senior Thesis Mentor**, Cindy Cao	2019-2021
-	**Graduate Teaching Assistant**, ChE 141: Data Science for Chemical Systems	2020
-	**Graduate Teaching Assistant**, ChE 103c: Transport Phenomena (Mass Transport)	2018-2019
-	**Certificate of Practice in University Teaching**, Caltech Center for Learning and Teaching Outreach	2018-2020
-	**Undergraduate Research Mentor**, Samuel Owens	2017

University of Florida

-	**Society for Biomaterials Education Challenge**, Society for Biomaterials, University of Florida Chapter	2015
-	**Tutoring for Engineering Excellence (TEE) Chair**, Tau Beta Pi, Florida Alpha Chapter	2014-2015