YAN ZHANG

Postdoctoral Scholar Research Associate
Division of Chemistry & Chemical Engineering
California Institute of Technology

yzhang952.github.io
yz473@caltech.edu
she/her/hers

RESEARCH INTEREST

My research vision is to enable Biology-by-Design – creating synthetic biological systems from the ground up with a defined purpose. My research program will initially focus on developing synthetic bacteriophages, viruses that specifically infect bacterial hosts, with applications in phage therapy against antibiotic resistance, targeted gene delivery, and precision microbial community control.

EDUCATION

2022 **Georgia Institute of Technology** Atlanta, GA
Doctor of Philosophy in Chemical & Biomolecular Engineering
Thesis: New Interfaces to Advance Point-of-Care Biosensor Diagnostics

2017 **Cornell University** Ithaca, NY
Bachelor of Science in Chemical & Biomolecular Engineering, *Cum Laude*

RESEARCH EXPERIENCES

2024 **Postdoctoral Scholar Research Associate, Caltech**
Advisors: Prof. William M. Clemons and Prof. Richard M. Murray, Division of Chemistry and Chemical Engineering and Division of Biology and Biological Engineering

- Develop cell-free expression platforms to produce bacterial viruses and virus-like particles for applications in phage therapy and custom gene delivery
- Modularize bacterial virus genomes to enable rapid reconfiguration for therapeutic applications and precision microbial control.

This independent research direction has received $120,000 in funding from Caltech's internal research awards and an impact score of 20 for the NIH MOSAIC K99/R00 Postdoctoral Career Transition Award.

2022 **Presidential Postdoctoral Fellow, Caltech**
Advisor: Prof. Richard M. Murray, Division of Biology and Biological Engineering

- Leverage mass spectrometry-based proteomics to characterize cell-free proteome composition
- Utilize proteomics to identify sources of inter-lab cell-free system variability

This work was supported by Caltech's Presidential Postdoctoral Fellowship and resulted in 1 manuscript preprint on *BioRxiv*, pending journal submission.

2017 **Graduate Research Assistant, Georgia Tech**
Advisor: Prof. Mark P. Styczynski, School of Chemical & Biomolecular Engineering

- Innovated protocell arrays platform interfacing cell-free biosensors with polymer biphasic system for multiplexed analyte detection
- Integrated cell-free systems to a personal glucose monitor for field-deployable analyte quantification
- Characterized the effect of different lysate preparation methods on cell-free protein production and central metabolism

This work has resulted in 7 publications in *Nature Communications*, *Science Advances, ACS Synthetic Biology, PLoS Biology, Journal of Chemical Engineering Data*, and 1 book chapter contribution.

2015 **Undergraduate Research Assistant, Cornell University**
Advisors: Prof. Julius B. Lucks (now at Northwestern University) and Prof. Jeffrey D. Varner, School of Chemical and Biomolecular Engineering

- Simulated RNA negative autoregulation network using mass action kinetics model to predict output
- Prototyped RNA networks in cell-free systems and implemented design in *E. coli* cells

This work resulted in 1 third-author publication in *ACS Synthetic Biology* and 1 second-author manuscript in preparation.

GRANT WRITING EXPERIENCES

2024 **NIH R21 Exploratory/Developmental Research Grant** (submitted)
"In Vitro Production of Modular Bacteriophages for Targeted Gene Delivery and Therapeutic Applications," Yan Zhang, William Clemons (PI), Kaihang Wang (Co-PI).

2024 **Caltech Rosen Bioengineering Center Pilot Grant** (Funded for $80,000)
"In Vitro Phage Synthesis for High-Throughput Engineering and Phage-Inspired Designs," Yan Zhang, William Clemons (PI), Kaihang Wang (Co-PI)

2024 **NIH MOSAIC K99/R00 Postdoctoral Career Transition Award** (NIBIB, Impact Score 20, Council Review completed)
"An Adaptive Framework to Synthesize and Reconfigure Bacterial Viruses (Phages) to Counter Antibiotic Resistance," Yan Zhang (PI)

2023 **Caltech Center for Environmental Microbial Interactions Pilot Grant** (Funded for $40,000)
"Cell-Free Systems as a Universal Platform for Phage Production." Yan Zhang, Zachary A. Martinez, Richard M. Murray (PI)

FELLOWSHIPS, AWARDS, AND HONORS

2024 AIChE Women-in-Chemical Engineering (WIC) Travel Award
2023 Best Ph.D. Thesis Award, Georgia Tech Chapter of Sigma Xi
2022 Caltech Presidential Postdoctoral Fellowship

2022 MIT Rising Stars in Chemical Engineering
2022 Georgia Tech Office of the Executive Vice President for Research (EVPR) Poster Award
2022 First Place, Georgia Tech F. L. "Suddath Fellowship Award
2021 Most Dedicated Mentor Award in the 2021 iGEM Mentorship Program
2021 Georgia Tech Research Institute (GTRI) Graduate Student Fellow
2021 Georgia Tech ChBE Garry Betty Chair Fellowship
2018 Honorable Mention in NSF Graduate Research Fellowship
2016 Chi Alpha Epsilon National Honor Society Inductee
2016 Philips 66 Scholarship
2015 Ronald E. McNair Post-Baccalaureate Scholar

PUBLICATIONS

Journal Articles

10. Hu, C. Y., **Zhang, Y.**, Sun, Y., Lucks, J. B. (*in preparation*) RNA-Overload Amplifies the Dynamic Range of Transcription Regulators.
9. **Zhang, Y.**, Deveikis, M., Qiu, Y., Björn, L., Martinez, Z. A., Chou, T., Freemont, P. S., Murray, R. M. (*pending journal submission)* Optimizing Protein Production in One-Pot PURE Systems: Insights into Reaction Composition and Expression Efficiency. [link to *BioRxiv* preprint]
8. McSweeney, M. A., **Zhang, Y.**, Styczynski, M. P. (2023). Short Activators and Repressors of RNA Toehold Switches. *ACS Synth Biol*, *12*(3), 681-688. [link]
7. Ahmed, T., **Zhang, Y.**, Lee, J.-H., Styczynski, M. P., & Takayama, S. (2022). Nucleic Acid Partitioning in PEG-Ficoll Protocells. *Journal of Chemical & Engineering Data*, *67*(8), 1964-1971. [link]
6. **Zhang, Y.**, Steppe, P. L., Kazman, M. W., & Styczynski, M. P. (2021). Point-of-Care Analyte Quantification and Digital Readout via Lysate-Based Cell-Free Biosensors Interfaced with Personal Glucose Monitors. *ACS Synth Biol*, *10*(11), 2862-2869. [link]
5. **Zhang, Y.**, Kojima, T., Kim, G. A., McNerney, M. P., Takayama, S., & Styczynski, M. P. (2021). Protocell Arrays for Simultaneous Detection of Diverse Analytes. *Nat Commun*, *12*(1), 5724. [link]
4. Miguez, A. M., **Zhang, Y.**, Piorino, F. & Styczynski, M. P. (2021). Metabolic Dynamics in Escherichia coli-Based Cell-Free Systems. *ACS Synth Biol*, *10*(9), 2252-2265. [link]
3. Byagathvalli, G., Sinha, S., **Zhang, Y.**, Styczynski, M. P., Standeven, J., & Bhamla, M. S. (2020). Electropen: an Ultra-Low-Cost, Electricity-Free, Portable Electroporator. *PLoS Biol*, *18*(1), e3000589. [link]
2. McNerney, M. P., **Zhang, Y.**, Steppe, P., Silverman, A. D., Jewett, M. C., & Styczynski, M. P. (2019). Point-of-Care Biomarker Quantification Enabled by Sample-Specific Calibration. *Sci Adv*, *5*(9), eaax4473. [link]

1. Hu, C. Y., Takahashi, M. K., **Zhang, Y.**, & Lucks, J. B. (2018). Engineering a Functional Small RNA Negative Autoregulation Network with Model-Guided Design. *ACS Synth Biol, 7*(6), 1507-1518. [link]

Book Chapters Contributed

2. **Zhang, Y.** and Hu, C. Y. (*accepted*). Chapter 13: Spatially Organized Circuits – Background: Compartmentalization in Biology. *The Art of Molecular Programming*. Molecular Programming Society. [link]

1. Miguez, A. M., **Zhang, Y.**, Styczynski, M. P. (2022). Metabolomics Analysis of Cell-Free Expression Systems Using Gas Chromatography-Mass Spectrometry. In: Karim, A. S., Jewett, M. C. (eds) *Cell-Free Gene Expression: Methods and Protocols*, vol 2433. Humana, New York, NY. [link]

Research Roadmap Contributed

3. Engineering Biology Research Consortium (2024). *Engineering Biology for Space Health: An innovative research roadmap*. [link]
2. Engineering Biology Research Consortium (2023). *An Assessment of Short-Term Milestones in EBRC's 2019 Roadmap, Engineering Biology*. [link]
1. Engineering Biology Research Consortium (2022). *Engineering Biology for Climate & Sustainability: A Research Roadmap for a Cleaner Future*. [link]

PRESENTATIONS

Select Talks

8. "*Optimizing Protein Production in One-Pot PURE Systems: Insights into Reaction Composition and Expression Efficiency.*" Selected abstract. Build-A-Cell Weekly Seminar Series, Virtual, April 2025 (tentative).
7. "*Optimizing Protein Production in One-Pot PURE Systems: Insights into Reaction Composition and Expression Efficiency.*" Selected abstract. 13th International Conference on Biomolecular Engineer, Houston, TX, January 2025 (tentative).
6. *"Protocell Arrays for Simultaneous Detection of Diverse Analytes."* Guest presentation. Paul Freemont and Yuval Elani Group, Imperial College London, London, U.K., April 2023.
5. *"Protocell Arrays for Simultaneous Detection of Diverse Analytes."* Young speaker. Synthetic Biology Young Speaker Series (SynBYSS), Global Virtual Seminar. March 2023. [video link]
4. *"New Interfaces for Cell-free Biosensors to Enable Multiplexed Analyte Detection and Quantification at the Point of Care."* Award Winner Presentation. Suddath Symposium, Virtual. January 2022.
3. *"The Sweet Solution to Sensing: Repurposing Glucose Monitors to Detect Micronutrient Deficiency and Pathogenic Bacteria."* Selected abstract. Georgia Tech School of Chemical & Biomolecular Engineering 33rd Annual Graduate Research Symposium, Virtual. February 2021.

2. *"Multiplexed Biomarker Detection in Cell-Free System via Aqueous Two-Phase System."* Department seminar. Georgia Tech School of Chemical & Biomolecular Engineering 4th Year Colloquium, Virtual. August 2020.
1. *"Multiplexing Cell-Free Diagnostics via Aqueous Two-Phase System."* Selected abstract. Engineering Biology Research Consortium (EBRC) Annual Meeting, Virtual. April 2020.

Select Posters

6. "*Optimizing Protein Expression in One-Pot PURE systems: Insights into Reaction Composition and Translation Efficiency.*" Synthetic Biology: Engineering, Evolution, and Design (SEED), Atlanta, GA. June 2024.
5. *"Composition of the One-Pot PURE Reaction Environment and Its Influence on Protein Expression."* Engineering Biology Research Consortium (EBRC) Annual Meeting, Atlanta, GA. May 2024.
4. *"Protocell Arrays for Simultaneous Detection of Diverse Analytes."* Synthetic Biology: Engineering, Evolution, and Design (SEED), Arlington, VA. May 2022.
3. *"A Sweet Solution to Sensing: Repurposing Personal Glucose Monitors to Detect Diverse Classes of Biomarkers."* Georgia Tech Career, Research, and Innovation Development Conference (CRIDC), Atlanta, GA. January 2022.
2. *"Cell-Free System in Aqueous Two-Phase Enables Multiplexing of Small Molecule and Nucleic Acids."* Synthetic Biology: Engineering, Evolution, and Design (SEED), New York, NY. June 2019.
1. *"Cell-Free System in Aqueous Two-Phase Enables Multiplexing of Small Molecule and Nucleic Acids."* Engineering Biology Research Consortium (EBRC) Spring Retreat, Boston, MA. February 2019.

MENTORING EXPERIENCE

2024 **Caltech Summer Undergraduate Research Fellowship (SURF)**
- Lovisa Björn, Lund University, Sweden

2022 **Caltech Connection Mentoring and Outreach Program**
- Sheung Ho Lam, undergraduate mentee from Pasadena City College

2022 **EBRC Mentorship for Undergraduate and Master Students (EMUMS)**
- Czarlyn Cumba, undergraduate mentee from California State University, Northridge

2018- **International Genetically Engineered Machines (iGEM) Competition**
- Federal University of Rio de Janeiro (Brazil), over-graduate team
- Zhejiang University of Technology, collegiate team
- University of Maryland, collegiate team (*recognized with Most Dedicated Mentor Award*)
- Lambert High School, high school team

2018 **Undergraduate Research in Styczynski Lab, Georgia Tech**
- Vidhya M. Mallikarjunan, ChemE major undergraduate researcher

- Maxwell W. Kazman, ChemE major undergraduate researcher (NSF-GRFP '23)
- Paige L. Steppe, ChemE major undergraduate researcher (NSF-GRFP '22)
- Niya J. Ford, ChemE major undergraduate researcher

TEACHING EXPERIENCE

Georgia Tech

2022
- ChBE 3200: Transport Phenomenon I (*co-instructor for Tech-to-Teaching capstone*)

2019
- ChBE 4510: Process and Product Design and Economics (*graduate teaching assistant*)

2018
- ChBE 2120: Numerical Methods in Chemical Engineering (*graduate teaching assistant*)

Cornell University

2017
- CHEME 3320: Analysis of Separation Processes *(undergraduate teaching assistant)*

2016
- CHEME 3130: Thermodynamics *(undergraduate teaching assistant)*

SERVICE AND OUTREACH

2023 **Journal Reviewer**
- ACS Sensors

Undergraduate Research at Caltech

2024
- Summer Undergraduate Research Fellowship (SURF), *Reviewer*

2023
- Summer Undergraduate Research Fellowships (SURF), *Presentation Judge*

Engineering Biology Research Consortium (EBRC)

2024
- Policy and International Engagements Working Group, *Liaison*

2022
- Graduate Student & Postdoc Association (SPA) Board, *Vice President*

2021
- Government and Industry Mentorship Program, *Co-chair*

2021
- Undergraduate Societies Outreach Initiative, *Co-lead*

2022 **Molecular Programming Society**
- Art of Molecular Programming Grass-root Textbook Initiative, *Editor*

2020 **International Genetically Engineered Machine (iGEM) Community**
- iGEM Giant Jamboree, *Judge*

2018 **Undergraduate Research at Georgia Tech**
- President's Undergraduate Research Award, *Reviewer*

PROFESSIONAL DEVELOPMENT

2022 Center for the Integration of Research, Teaching, and Learning (CIRTL) Associate Level Certificate

2022 Tech-to-Teaching Certificate in College Teaching, Georgia Tech