YAN ZHANG

Postdoctoral Scholar Research Associate
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RESEARCH INTEREST

My research program takes a cell-free synthetic biology approach to deconstruct and reconstruct bacteriophages, viruses that infect bacteria, to reveal context-dependent regulatory principles and enable application-driven design of therapeutic phages and biopesticides.

EDUCATION

Georgia Institute of Technology, Atlanta, GA — 2022

Doctor of Philosophy in Chemical & Biomolecular Engineering
Thesis: New Interfaces to Advance Point-of-Care Biosensor Diagnostics

Cornell University, Ithaca, NY — 2017

Bachelor of Science in Chemical & Biomolecular Engineering

RESEARCH EXPERIENCE

NIH MOSAIC K99/R00 Postdoctoral Fellow, Caltech — 2024

Advisor: Prof. William M. (Bil) Clemons, Division of Chemistry and Chemical Engineering

- Design cell-free expression system to produce biomedical- and agricultural-relevant phages

  This independent research direction has received a total of $290,000 in funding from Caltech's internal research awards and the NIH MOSAIC K99/R00 Postdoctoral Career Transition Award.

Presidential Postdoctoral Fellow, Caltech — 2022

Advisor: Prof. Richard M. Murray, Division of Biology and Biological Engineering

- Identified and resolved proteomic and biochemical factors contributing to interlaboratory variability in cell-free system productivity

  This work was supported by Caltech's Presidential Postdoctoral Fellowship and resulted in 1 first and corresponding author publication in *ACS Synthetic Biology*.

Graduate Research Assistant, Georgia Tech — 2017

Advisor: Prof. Mark P. Styczynski, School of Chemical & Biomolecular Engineering

- Interfaced cell-free biosensors with polymer biphasic system for multiplexed analyte detection
- Integrated cell-free biosensors to personal glucose monitors for analyte quantification
- Characterized different lysate preparation methods on cell-free system yield and metabolism

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

Undergraduate Research Assistant, Cornell University — 2015

Advisors: Prof. Julius B. Lucks, School of Chemical & Biomolecular Engineering

- Prototyped RNA regulators 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 for journal submission.

GRANT WRITING EXPERIENCE

Caltech Resnick Sustainability Center Explorer Grant (Funded for $150k) 2025
"A Host-Independent, Cell-Free Biomanufacturing Platform to Produce Plant Pathogen-Targeting Bacteriophages for Sustainable Agricultural Biocontrol"
Yan Zhang (conceived and authored the proposal), Bil Clemons (PI), Richard Murray (Co-PI)

Caltech Center for Evolutionary Science Seed Grant (Funded for $20k) 2025
"Deciphering the Evolution of Protein Cages with Deep Learning"
Zachary Martinez, Yan Zhang (co-conceived and co-authored the proposal), Matt Thomson (PI), Bil Clemons (Co-PI)

NIH MOSAIC K99/R00 Postdoctoral Career Transition Award (Funded for $1 Million) 2024
"An Adaptive Framework to Synthesize and Reconfigure Bacterial Viruses (Phages) to Counter Antibiotic Resistance,"
Yan Zhang (PI)

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

Caltech Center for Environmental Microbial Interactions Pilot Grant (Funded for $40k) 2023
"Cell-Free Systems as a Universal Platform for Phage Production."
Yan Zhang (conceived and authored the proposal), Richard M. Murray (PI)

PUBLICATIONS

Journal Articles

10. Hu, C. Y., **Zhang, Y.**, Sun, Y., Lucks, J. B. (*in preparation for submission*) RNA-Overload Amplifies the Dynamic Range of Transcription Regulators. [Draft available upon request]
9. **Zhang, Y*.**, Deveikis, M., Qiu, Y., Björn, L., Martinez, Z. A., Chou, T., Freemont, P. S., Murray, R. M. (2025). Optimizing Protein Production in One-Pot PURE Systems: Insights into Reaction Composition and Expression Efficiency. *ACS Synth Biol.* [link]
*corresponding author
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. 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

Talks

8. "*Designing the Cell-Free Gene Expression Environment*" Selected abstract. **American Chemical Society (ACS) Fall Meeting**, Washington DC., August 2025. [slides]
7. "*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. [video link]
6. "*Optimizing Protein Production in One-Pot PURE Systems: Insights into Reaction Composition and Expression Efficiency.*" Selected abstract. **13th International Conference on Biomolecular Engineering**, Houston, TX, January 2025. [slides]
5. *"Protocell Arrays for Simultaneous Detection of Diverse Analytes."* Young speaker. **Synthetic Biology Young Speaker Series (SynBYSS)**, Virtual, 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.

FELLOWSHIPS, AWARDS, AND HONORS

Chemical Abstract Services (CAS) Future Leader, American Chemical Society 2025
Women-in-Chemical Engineering Travel Award, American Institute of Chemical Engineers 2024
Best Ph.D. Thesis Award, Georgia Tech Chapter of Sigma Xi 2023
Rising Stars in Chemical Engineering, Massachusetts Institute of Technology 2022
Best Poster Award, Georgia Tech Office of the Executive Vice President for Research 2022
First Place in F. L. Suddath Fellowship Award, Georgia Tech 2022
Most Dedicated Mentor Award, iGEM Mentorship Program 2021
Garry Betty Chair Fellowship in Chemical Engineering, Georgia Tech 2021
Honorable Mention in NSF Graduate Research Fellowship 2018
Chi Alpha Epsilon National Honor Society Inductee, Cornell University 2016
Philips 66 Scholarship, Cornell University 2016
Ronald E. McNair Post-Baccalaureate Scholar, Cornell University 2015

MENTORING EXPERIENCE

Caltech Summer Undergraduate Research Fellowship (SURF) 2024-
- Grace Tuhabonye, Chemical Engineering, Caltech
- Lovisa Björn, Lund University, Sweden

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

International Genetically Engineered Machines (iGEM) Competition 2018-
- 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

Undergraduate Research in Styczynski Lab, Georgia Tech 2018-
- Vidhya M. Mallikarjunan, ChBE major undergraduate researcher
- Maxwell W. Kazman, ChBE major undergraduate researcher (NSF-GRFP ‘23)
- Paige L. Steppe, ChBE major undergraduate researcher (NSF-GRFP ‘22)
- Niya J. Ford, ChBE major undergraduate researcher

TEACHING EXPERIENCE

Georgia Tech
- ChBE 3200: Transport Phenomenon I (*co-instructor for Tech-to-Teaching capstone*) 2022
- ChBE 4510: Process and Product Design and Economics (*graduate teaching assistant*) 2019
- ChBE 2120: Numerical Methods in Chemical Engineering (*graduate teaching assistant*) 2018

Cornell University
- CHEME 3320: Analysis of Separation Processes *(undergraduate teaching assistant)*
- CHEME 3130: Thermodynamics *(undergraduate teaching assistant)* 2017
2016

SERVICE AND OUTREACH

Journal Reviewer 2023-
- ACS Sensors

Undergraduate Research at Caltech
- Summer Undergraduate Research Fellowship (SURF), *Reviewer* 2024
- Summer Undergraduate Research Fellowships (SURF), *Presentation Judge* 2023

Engineering Biology Research Consortium (EBRC)
- Policy and International Engagements Working Group, *Liaison* 2024-
- Graduate Student & Postdoc Association (SPA) Board, *Vice President* 2022
- Government and Industry Mentorship Program, *Co-chair* 2021

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

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

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

PROFESSIONAL DEVELOPMENT

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

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