

# Zeyu (Alban) Li

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Ph.D. candidate in Biological & Environmental Engineering at Cornell University. Developing **DNA-polymer nanoparticle tracers** for large-scale hydrological monitoring and **DNA-composite hydrogels** for self-healing and stimulus-responsive structural materials. Led a 7-research-group, four-discipline collaboration that field-deployed tracers across an 11 km<sup>2</sup> lake, while driving an independent program on programmable, 3D-printable DNA hydrogels. Core strengths include **nanoparticle fabrication, additive manufacturing, polymer / biomaterials engineering, and advanced materials characterization**; co-author of peer-reviewed publications and co-inventor on a U.S. patent.

## EDUCATION

### Cornell University

Ithaca, NY

Ph.D. in Biological and Environmental Engineering

May 2026

M.Eng. in Biological and Environmental Engineering

May 2020

*DNA Materials Lab, Advisor: Dan Luo*

### Hong Kong Baptist University

Kowloon, Hong Kong

B.Sc. (Hons.) in Chemistry (Major), Computer Science (Minor)

Jun 2019

*Microfabrication & Surface Materials Lab, Supervisor: Kangning Ren*

## EXPERIENCE

### Graduate Research Assistant

Ithaca, NY

DNA Materials Lab, Cornell University

Feb 2021 - Present

- **DNA-polymer nanoparticle tracers.** Fabricate via emulsion and electrospray, and field-deployed across an 11 km<sup>2</sup> sector of Cayuga Lake; coordinated 4 disciplines (hydrology, ecology, environmental science, materials engineering); achieved robust qPCR detection 7 km from release with only 1 mg DNA; generated data that now calibrate 3D hydrodynamic eDNA-transport models. (*Li et al.* first author, under review 2025).
- **Self-healing DNA hydrogels for ceramic composite repair.** Developed DNA-Al<sup>3+</sup> hydrogels and integrated them into CAD designed, 3D printed vascular tiles with an architecture research team; restored crack integrity through multiple damage-heal cycles and verified performance by tensile testing the healed specimens and using EDS to confirm elemental distribution—altogether demonstrating the hydrogel's autonomous repair potential for infrastructure materials. (results published in *ACADIA 2024*).
- **Photo-/thermo-reversible psoralen-clamped DNA hydrogels.** Developed dual-network gels whose psoralen “molecular clamps” lock under 365 nm light and unlock under 254 nm, enabling 3D-printable, time-programmed shape fixing and multi-cycle self-repair via localized light-heat cues.
- **Automated high-throughput DNA-purification platform.** Designed and validated a coffee-machine-style, perfluorocarbon pod system that performs continuous biomass-solution extraction, yields 200 mg DNA per disposable pod (chainable for gram-scale output), and cuts purification cost by 91 % versus kit methods, providing low-cost feedstock for hydrogel and plastic fabrication.
- **Advanced characterization and mechanical testing.** Performed tensile and rheological measurements; conducted SEM imaging, DLS particle sizing, UV-Vis/fluorescence spectroscopy, contact-angle goniometry, and EDS elemental mapping to build structure-property datasets that guided design iterations and validated performance targets across all DNA-based materials projects.
- **Laboratory leadership and dissemination.** Mentored 3 undergraduate researchers and oversaw daily lab operations and safety; co-authored three peer-reviewed publications, presented and published results at ACADIA 2024, ACS Fall 2023, and the Belt-and-Road Youth Forum 2023.

### Graduate Teaching Assistant

Ithaca, NY

Department of Biological and Environmental Engineering, Cornell University

Feb 2021 - Present

- **Course instruction and lab support.** Assisted faculty across 7 courses in bio-design, molecular and cellular engineering, watershed systems, engineering professionalism, and sustainable development; prepared recitation slides, demonstrated laboratory procedures, and managed course materials on Canvas.

- **AI-driven teaching and curriculum development.** Delivered guest lectures across courses to train students in leveraging AI for learning and research, while integrating AI tools into assignments, review sessions and data analysis.

## Undergraduate Research Assistant & Senior Research Assistant

Kowloon, Hong Kong

Hong Kong Baptist University

Jun 2017 - Aug 2019 & Oct 2020 - Jan 2021

- **Superhydrophobic fluoropolymer surfaces.** Engineered nanopatterned Teflon films, fabricated with assistance from photolithography, two-photon lithography, and chemical etching, achieving ultra-low wettability and high mechanical durability; contributed to a peer-reviewed article and a U.S. patent on hierarchical surface architectures.
- **Environmental-simulation platform.** Designed and built an automated chamber that controls humidity, temperature, and airflow to enable precise wetting-behavior and coating-durability testing.
- **Static-electricity anti-icing study.** Led an independent investigation of charge-mediated ice shedding, culminating in a top-rated undergraduate thesis.

## Research Exchange Program

Atlanta, GA

Georgia State University

Jun 2018 - Aug 2018

- **Protein–DNA interaction kinetics.** Characterized PU.1 transcription-factor binding affinity and rate constants to DNA using Localized Surface Plasmon Resonance (LSPR).

## PUBLICATIONS & PATENTS

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- Li, Z., Ramón, C. L., Koeberle, A., et al. "Synthetic eDNA Particles for Tracing and Modeling Environmental DNA Transport in a Large Lake System" Environmental Science & Technology (2025), (Manuscript under review).
- He, C., Li, Z., Wang, L. X., et al. "PolyTile 4.0: Self-healing Ceramic Tiles" ACADIA (2024).
- Li, W., Chan, C. W., Li, Z., et al. "All-perfluoropolymer, nonlinear stability-assisted monolithic surface combines topology-specific superwettability with ultradurability." The Innovation (IF = 25.7), 4(2), 100299, (2023).
- Ren, K., Wu, H., Wang, Z., Yao, S., Ong, B., Li, W., Li, Z., Sun, H., & Chan, C.W. "Crack engineering as a new route for the construction of arbitrary hierarchical architectures." US Patent 11,839,998, (2023).
- Li, Q., Li, Z., & Lin, Z. "Reactor and method of spiral propulsion biomass continuous thermal cracking." Chinese Patent 201711214139.6 (2017).

## CONFERENCE PRESENTATIONS

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- Oral Presentation: "DNA Nano Tracer for Hydrological and Environmental Science Study" The First Belt and Road Youth International Forum for Green Low Carbon Innovation and Development, Anji, China (2023).
- Poster Presentation: "DNA-PLGA Nanosphere Tracers: A reliable Tool for Studying Environmental DNA (eDNA) Transport in Aquatic Ecosystems" ACS Fall 2023 National Meeting, San Francisco, CA, (2023).

## SKILLS

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**Materials Characterization:** SEM, DLS, EDS, UV-Vis Spectroscopy, Fluorometry, Rheometry, Electrophoresis, Tensile Testing, Contact Angle Measurement.

**Fabrication & Processing:** Electrospray, DIW 3D Printing, SLA/FDM Printing (Polymers & Ceramics), Spin Coating, Mold Casting, Solvent Precipitation, Photolithography, Two-Photon Lithography, Nanopatterning.

**Molecular & Bioengineering Techniques:** PCR, qPCR, IVT, Electrophoresis(PAGE, Agarose), DNA/RNA Extraction & Purification, Chromatography Column Design, Enzyme Recycling, LSPR-based Binding Assays, Bio-cleanroom Protocols.

**Programming & Computational Modeling:** Python, Java, Basic Machine Learning (TensorFlow, PyTorch), Data Analysis & Visualization (Pandas, NumPy, Seaborn), Computer Science Minor (Hong Kong Baptist University).

**2D/3D Design & Visualization:** CAD, SketchUp, Autodesk 3ds Max, Adobe Creative Suite (Illustrator, Photoshop, InDesign), Bootstrap Studio, Scientific Figure Production, Video & Audio Editing.

**Languages:** English (Fluent), Mandarin (Native), Cantonese (Proficient).