Alam Mahmud, PhD

Postdoctoral Scholar
Department of Chemical Engineering
Stanford University
mahmud@stanford.edu

EDUCATION

University of Toronto

Ph.D., Electrical & Computer Engineering 2023

Dissertation: *Programmable Self-Regenerating Bioelectronic Devices*

Supervisor: Ted Sargent

Advisor: Shana Kelley (Faculty of Pharmacy)

University of Waterloo

M.A.Sc., Electrical & Computer Engineering — Nanotechnology 2018

Thesis: *Advanced Nanoelectromechanical Systems for Next-Generation Energy Harvesting*

Bangladesh University of Engineering and Technology

B.Sc.Eng., Electrical & Electronic Engineering 2015

Thesis: *Carbon Nanotube Field-Effect Transistor-Based Operational Amplifiers*

INTERDISCIPLINARY TRAINING

McGill University

NSERC CREATE PROMOTE Program 2020–2023

Department of Chemistry

University of British Columbia

NMIN's Highly Qualified Personnel Program 2020–2022

NanoMedicines Innovation Network (NMIN), Faculties of Medicine & Pharmaceutical Sciences

RESEARCH EXPERIENCE

Postdoctoral Scholar 2023–Present

Department of Chemical Engineering, Stanford University

Advisor: Zhenan Bao

Focus: *Carbon-based electronic interfaces for direct molecular measurements*

Additional affiliations: Department of Comparative Medicine, Stanford School of Medicine; Stanford Wearable Electronics Initiative; Center for Precision Mental Health & Wellness

Collaborations: Chan Zuckerberg Biohub San Francisco; DeSimone Laboratory, Stanford University

Predoctoral Fellow 2022–2023

Department of Chemistry, Northwestern University

Advisor: Shana Kelley

Focus: *Bioreceptor-functionalized electronic interfaces for continuous biomolecular monitoring*

Selected collaborations: Rogers Research Group; Chan Zuckerberg Biohub Chicago

Graduate Research Intern 2022–2023

Querrey Simpson Institute for Bioelectronics, Northwestern University

Advisor: John Rogers

Training Program: NSERC Collaborative Research and Training Experience

Focus: *Flexible and wearable bioelectronics*

Doctoral Researcher 2019–2022

Faculty of Applied Science & Engineering and Faculty of Pharmacy, University of Toronto

Advisor: Shana Kelley

Ph.D. Supervisor: Ted Sargent

Focus: *Electrochemical and DNA-based strategies for self-regenerating molecular bioelectronics*

Selected collaborations: Wei Gao Laboratory, Caltech; Ted Rogers Centre for Heart Research; Sunnybrook Research Institute; Sinai Health System; Analog Devices Inc.; ARMA Biosciences

Research and Development Specialist 2018–2019

Waterloo Institute for Nanotechnology, University of Waterloo

Focus: *Self-powered sensors for structural health monitoring*

Industry Partnership: Shimco North America Inc.

Graduate Research Assistant 2016–2018

Department of Electrical & Computer Engineering, University of Waterloo

Advisor: Dayan Ban

Focus: *Nanogenerators for self-powered electronics*

Undergraduate Researcher 2015–2016

Department of Electrical & Electronic Engineering, BUET

Advisor: Sharif Mohammad Mominuzzaman

Focus: *Carbon nanotube field-effect transistors for analog ICs*

PUBLICATIONS

† Denotes equal contribution.

Preprints

1. **Mahmud A†**, Zhao C†, Uwakwe C, Choi IR, Chen T, Hsu K-J, DeFelice B, Gray I, Hwang J, Ilyn D, Redvanly TW, Wei S, Weber I, Uruchurtu Patino D, Lin Y, Yu W, Lyu H, Chen Y, Xu C, Shi B, Sedano A, Heo J, Rijns L, DeSimone JM, Bao Z. Direct electrochemical cortisol detection via transition-resolved interrogation at a defect-engineered graphene interface. *bioRxiv* **2026**.09.13.751286; https://doi.org/10.64898/2026.09.13.751286

Manuscripts

2. **Mahmud A**, Wong A, Kim J, Hsu K-J, Bao Z. A laser-encoded graphene interface enables direct melatonin detection at physiological concentrations. *In internal revision.*

Peer-Reviewed Publications

3. Weber IC, Uruchurtu Patino D, Hsu K-J, Zosso Y, Düsselberg ALM, Chen T, Parkatzidis K, Wei S, **Mahmud A**, Bastide GMGBH, Remund AL, Wu MA, Bao Z. Sensitive hormone and neurotransmitter detection with carbon flower electrodes. *Advanced Functional Materials*. **2026**;36(40):e28595.

4. Flynn CD, Wu Z, Bantle A, Isaacson SE, Chang D, **Mahmud A**, Yousefi H, Das J, Kelley SO. Nanobody receptors enable high-sensitivity monitoring of IL-6 using molecular pendulum bioanalysis. *Analytical Chemistry*. **2025**;97(14):7825–7832.

5. **Mahmud A**, Chang D, Das J, Gomis S, Chen JB, Yousefi H, Pandey L, Sargent EH, Kelley SO. Monitoring cardiac biomarkers using aptamer-based molecular pendulum sensors. *Angewandte Chemie International Edition*. **2023**;62:e202213567.

6. Chang D†, Wang DZ†, Flynn CD, **Mahmud A**, Wang H, Geraili A, Li X, Zhang J, Sargent EH, Kelley SO. A high-dimensional microfluidic approach for selection of aptamers with programmable binding affinities. *Nature Chemistry*. **2023**;15:773–780.

7. Flynn CD, Chang D, **Mahmud A**, Yousefi H, Das J, Riordan K, Sargent EH, Kelley SO. Biomolecular sensors for advanced physiological monitoring. *Nature Reviews Bioengineering*. **2023**;1:560–575.

8. Clifford A, Das J, Yousefi H, **Mahmud A**, Chen JB, Kelley SO. Strategies for biomolecular analysis and continuous physiological monitoring. *Journal of the American Chemical Society*. **2021**;143(14):5281–5294.

9. Yousefi H†, **Mahmud A†**, Chang D†, Das J, Gomis S, Chen JB, Wang H, Been T, Yip L, Coomes E, Li Z, Mubareka S, McGeer A, Christie N, Gray-Owen S, Cochrane A, Rini JM, Sargent EH, Kelley SO. Detection of SARS-CoV-2 viral particles using direct, reagent-free electrochemical sensing. *Journal of the American Chemical Society*. **2021**;143(4):1722–1727.

10. Das J†, Gomis S†, Chen JB, Yousefi H, **Mahmud A**, Zhou W, Sargent EH, Kelley SO. Reagentless biomolecular analysis using a molecular pendulum. *Nature Chemistry*. **2021**;13:428–434.

11. **Mahmud A**, Khan AA, Voss P, Islam S, Ban D. Integration of organic/inorganic nanostructured materials in a hybrid nanogenerator enables efficacious energy harvesting via mutual performance enhancement. *Nano Energy*. **2019**;58:112–120.

12. Khan AA, **Mahmud A**, Voss P, Islam S, Ban D. A self-powered multi-broadcasting wireless sensing system realized with an all-in-one triboelectric nanogenerator. *Nano Energy*. **2019**;62:691–699.

13. Khan AA, **Mahmud A**, Ban D. Evolution of single to hybrid nanogenerator: A contemporary review on multimode energy harvesting for self-powered electronics. *IEEE Transactions on Nanotechnology*. **2019**;18:21–36.

14. **Mahmud A**, Khan AA, Voss P, Das T, Abdel-Rahman E, Ban D. A high-performance consolidated piezoelectric energy harvester based on one-dimensional/two-dimensional hybrid zinc oxide nanostructures. *Advanced Materials Interfaces.* **2018**;5:1801167.

INTELLECTUAL PROPERTY

Issued Patents

- **Mahmud A**, Khan AA, Ban D, Voss P. *1D/2D Hybrid Piezoelectric Nanogenerator and Method for Making Same*. U.S. Patent 12,301,139 issued May 13, **2025.**

Patent Applications

- **Mahmud A**, Bao Z. *Transition-Resolved Biosensing at Carbon Interfaces.* U.S. Provisional Patent Application, Stanford Docket No. S26-442, filed September 11, **2026**.

- Kelley SO, Sargent EH, Das J, Gomis S, Ahmed S, Yousefi H, Chang D, **Mahmud A**. *Reagentless Electrochemical Biosensor*. U.S. Patent Application 17/904,846 published April 6, **2023**.

- Khan AA, **Mahmud A**, Zhang Y, Islam S, Voss P, Ban D. *Triboelectric Nanogenerator-Powered Transmission System*. U.S. Provisional Patent Application 62/853,101 filed May 27, **2019.**

Invention Disclosures

- Kelley SO, Yousefi H, **Mahmud A**, Chang D, Das J, Gomis S, Chen J. *Device and Method for Reagent-Free Electrochemical Quantification of Viral Particles*. Canadian Invention Disclosure No. 10004008, June 3, **2020**.

INVITED TALKS & SELECTED CONFERENCE PRESENTATIONS

2026 AIChE Annual Meeting – Meet the Candidates Poster Session, Minneapolis, MN.
Carbon Electronics for Real-Time Biology.

2026 Wu Tsai Human Performance Alliance Research Symposium, Stanford, CA. (**Invited**)
Stress, Sleep, and Human Performance: Toward a Molecular Understanding.

2024 Chan Zuckerberg Biohub San Francisco Inter-Lab Confab, San Francisco, CA. (**Invited**)
Skin-Inspired Materials and Devices for Biomedical Research and Precision Health.

2021 31st Anniversary World Congress on Biosensors, Virtual. (**Invited**)
Reagent-Free Electrochemical Sensor for Intact SARS-CoV-2 Viral Detection.

Additional Conference Presentations

2023 ACS Fall Meeting, San Francisco, CA

2023 Gordon Research Conference on Bioelectronics, Andover, NH

2022 MRS Spring Meeting & Exhibit, Honolulu, HI

2021 American Heart Association Scientific Sessions, Boston, MA

2019 International Conference on Nanoenergy and Nanosystems, Nanjing, China

2018 International Conference & Exhibition on Advanced & Nano Materials, Québec City, QC

2018 MRS Electronic Materials Conference, Santa Barbara, CA

HONORS & AWARDS

JEDI (**J**ustice, **E**quity, **D**iversity, and **I**nclusion) Champion Award, Stanford University	2024
Predoctoral Fellowship, Northwestern University	2022–2023
NSERC CREATE PROMOTE Fellowship, McGill University	2020–2023
University of Toronto Fellowship, Department of Electrical and Computer Engineering	2019–2023
Edward S. Rogers Sr. Graduate Scholarship, University of Toronto	2019
Nanofellowship, Waterloo Institute for Nanotechnology	2017
Teaching Assistantship Excellence Award, University of Waterloo	2017
Faculty of Engineering Award, University of Waterloo	2017
Nanofellowship, Waterloo Institute for Nanotechnology	2016
International Master's Student Award, University of Waterloo	2016–2018
Dean's List Award, Bangladesh University of Engineering and Technology	2015
University Merit Scholarship, Bangladesh University of Engineering and Technology	2010–2015

SELECTED GRANT CONTRIBUTIONS

NIH BRAIN Initiative U01 – Brain Behavior Quantification & Synchronization Program: Overview and Sensors Technology *(Pending)*

Principal Investigator: Zhenan Bao

Contribution: *ISF-based cortisol and melatonin sensing; in vivo validation in pain-induced stress models*

DARPA NTRAIN – Normalizing Timing of Rhythms Across Internal Networks of Circadian Clocks *(Funded)*

Principal Investigator: Shana Kelley

Contribution: *Electrochemical strategies for continuous circadian biomarker monitoring; sensor development and validation*

NIH Catalyze – Enabling Technologies and Transformative Platforms for HLBS Research *(Funded)*

Principal Investigator: Shana Kelley

Contribution: *Direct electrochemical sensing of small-molecule hormones; molecular-pendulum-based sensing of cortisol*

Toronto COVID-19 Action Fund *(Funded)*

Principal Investigator: Shana Kelley

Contribution: *Reagent-free electrochemical sensing for rapid SARS-CoV-2 detection; clinical validation*

University of Toronto Precision Medicine Initiative *(Funded)*

Principal Investigator: Shana Kelley

Contribution: *Reagent-free bioelectronic sensing technologies for precision molecular diagnostics*

RESEARCH MENTORING

Stanford University (Prof. Zhenan Bao)

Postdoctoral scholar (Kuang-Jung Hsu); MD–Ph.D. student (Chibuike Uwakwe); undergraduate researcher (Alvin Wang); SURF undergraduate fellow (Andrea Sedano)

University of Toronto & Northwestern University (Prof. Shana O. Kelley)

Postdoctoral scholar (Kefan Yang); graduate students (Fatemeh Esmaeili, Laxman Pandey, Kimberly Riordan, Zhenwei Wu)

ARMA Biosciences

Research engineers (Vishal Kale, Divya Dave)

University of Waterloo (Prof. Dayan Ban)

Graduate students (Asif Abdullah Khan, Masud Rana)

TEACHING

Founding Course Developer 2025

Stanford Biosciences, Stanford University

BIOS 405 — Electrochemistry for Nanobioengineering

Approved graduate course in the Stanford Biosciences curriculum; inaugural offering forthcoming.

Teaching Assistant 2017–2018

Electrical and Computer Engineering, University of Waterloo

ECE 231 — Semiconductor Physics and Devices

Teaching Assistant 2018

Nanotechnology Engineering, University of Waterloo

NE 345 — Photonic Materials and Devices

University Lecturer 2015–2016

Mechanical Engineering, Sonargaon University

EEE 159/160 — Fundamentals of Electrical Engineering & Laboratory

EEE 259/260 — Electrical and Electronics Technology & Laboratory

PROFESSIONAL DEVELOPMENT

- Team-Building for Research Groups, Center for STEMM Mentorship, Stanford University
- Preparing for Faculty Careers, Stanford University School of Medicine
- Mini-MBA, McGill Executive Institute, McGill University
- Electrochemistry Summer Camp, Dept. of Materials Science and Engineering, University of Toronto
- Entrepreneurship Program, MaRS Discovery District

RESEARCH LEADERSHIP

Initiated and led an energy-harvesting subgroup in Prof. Dayan Ban's laboratory at the University of Waterloo, establishing a research direction that subsequently supported expanded externally funded work.

SERVICE

Journal Peer Review

Independent reviewer for *Angewandte Chemie International Edition*, *Proceedings of the National Academy of Sciences*, *Science Advances*, *Advanced Functional Materials*, *Advanced Science*, *Biosensors and Bioelectronics*, *ACS Sensors*, *Nanotechnology*, and *Solid-State Electronics*.

Institutional Service

- Postdoctoral Representative, Diversity, Equity, and Inclusion Committee, Department of Chemical Engineering, Stanford University
- Health and Wellness Officer, Electrical and Computer Engineering Graduate Students' Society, University of Toronto

Outreach

- Volunteer, Black Engineer Week 2024, nano@Stanford
- Research Mentor, STEM Fellowship (University of Toronto Chapter)