

SAPTARSHI PAUL, PhD

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SUMMARY

- **Semiconductor process development specialist (PhD, Electroanalytical and Materials Chemistry):** Cu electrodeposition for interconnect metallization, translating chemical composition control, transport phenomena, and deposition surface science into reproducible, cost-reduced process protocols.
- **Materials characterization:** SEM-EDX-FIB, TEM-SAED, STEM-HAADF, XRD, XPS, FTIR and four-point probe for morphological, microstructural, compositional and electrical qualification of deposited films.
- **Semiconductor fabrication process:** lithography and etch (RIE, ICP) to define damascene trench/via geometry, and thin-film deposition (PVD, CVD, ALD, PECVD) for barrier, seed, and dielectric layers playing a vital role in preparing the surface ahead of Cu electrodeposition.
- **Cross-functional technical leadership:** manages an 8+ member UChicago–Argonne National Laboratory team building an autonomous Cu electrodeposition platform for microelectronics; coordinating chemistry, robotics, hardware, and software across two institutions in a matrix environment.
- Author of **14 peer-reviewed publications** (7 first author) and **1 filed patent** spanning electrochemistry. Presented **10+ talks** (invited and contributed), including 3 on semiconductor process development at **ACS, ECS, and MRS**. Presented process development results to external industrial (**Toyota**) and government stakeholders (**U.S. Department of Energy**).

RESEARCH EXPERIENCE

University of Chicago, Chicago, IL

Jan 2026 – Present

Molecular Engineering Dept.: Postdoctoral Researcher, Electroplating Process Development & Technical Integration

Process Integration, Deposition & Bath Chemistry

- Develop and optimize **Cu electroplating processes** (via DOE) on Si wafers, tuning bath chemistry and deposition parameters to improve film uniformity and conductivity with microstructure control tailored for **Cu-Cu (hybrid bonding) semiconductor packaging**. (manuscript under preparation)
- Assess deposited films to understand their morphology and microstructure via SEM-EDX, TEM-SAED and XRD.
- Conduct Root Cause Analysis (RCA) and Failure Analysis on process deviations such as identifying bath chemistry, substrate effects and different electrochemical and deposition parameters driving yield variability.

Project Management, Technical Integration & Cross-Functional Collaboration

- Managing UChicago–Argonne National Laboratory microelectronics team to build an autonomous lab for Cu electrodeposition in microelectronic study aimed at high-throughput data for favorable electroplating in trenches, through silicon vias (TSVs), and advanced interconnect architectures.
- **Support automation of experimental workflows** : Define experimental requirements and translate electrochemical and wet chemistry process constraints into specifications for robotics, hardware and software teams, supporting an automated and agentic driven deposition-to-characterization integrated workflow.
- **Coordinate execution across four technical functions:** electrochemistry, hardware design, robotics, and software team spanning two institutions in a matrix environment and integrate milestones under shifting priorities.

Purdue University, West Lafayette, IN

Aug 2022 – Jan 2026

PhD, Electroanalytical Chemistry: Innovating new Electrodeposition Processes for Energy Applications

Electrodeposition Process & Bath Chemistry Development

- Developed a bias-free, template-assisted microdroplet electrodeposition route to Cu and multi-component alloy electrodeposition at ambient conditions, removing applied-potential and thermal-budget requirements of conventional methods. (**patent filed**) (Published in *Small* (First Author)).
- Established **standardized protocols** for non-electrode coin-cell components, improving cross-lab reproducibility and process transferability (First Author, **EES Batteries front cover; Top 10% “Hot Article”**)
- Designed bath chemistry and process parameters for nanoparticle, thin-film synthesis and bulk deposition.

Transport Phenomena & Analytical Characterization

- Identified interfacial mass-transport and pH gradients governing coulombic efficiency at high current densities in aqueous Zn electrodeposition, directly informing process parameter limits and bath chemistry specifications (First Author, **Joule**, IF ~35, published in **Purdue News**).

- Analyzed the **morphological and microstructural changes** of Cu, Cu alloys and higher entropy alloys under changing electrochemical parameters. (First Author, **Langmuir and Electroanalysis**)
- Root-cause structural and compositional failure analysis of deposits using SPC and measurement system analysis (MSA) with SEM-EDX-FIB, TEM-SAED, STEM-HAADF, XRD, XPS and electrochemical data.

Leadership & Mentorship

- Lectured PhD-level courses in Analytical Chemistry and Electrochemistry;
- Mentored 3 researchers through independent electrochemistry projects, each resulting in a peer-reviewed co-authored publication.
- International Student Ambassador of Purdue: Organized 20+ events for international students in Purdue.

Indian Institute of Technology (IIT) Kanpur, India

2019 – 2021

M.S. Chemistry

Characterized light and heat-driven conformational switching in azobenzene systems via scanning tunneling microscopy (STM) and atomic force microscopy (AFM)

St. Xavier's College, India

B.S. Chemistry

2015 – 2018

Implemented a Fortran/Python-based Artificial Bee Colony algorithm for Lennard-Jones cluster global optimization.

TECHNICAL SKILLS

Metrology & Fabrication: SEM-EDX-FIB, TEM/STEM-HAADF, SAED, EELS, Cryo-EM, XRD, XPS, UV-Vis, FTIR, Raman, ellipsometry, four-point probe resistivity, surface reflectivity, FDTR, STM, AFM and Electrochemical techniques (CV, EIS, Deposition); Lithography, etching (RIE), thin-film deposition (PVD, CVD, ALD, PECVD).

Programming & Data Analysis: Python(Global Optimization; Automation), MATLAB, COMSOL, Fortran, Origin.

EDUCATION

Purdue University, West Lafayette, IN | PhD, Electroanalytical Chemistry

Aug 2022 – Jan 2026

Indian Institute of Technology (IIT) Kanpur, India | MS, Chemistry

2019 – 2021

St. Xavier's College, Kolkata, India | BS, Chemistry

2015-2018

PATENT

- Bias-Free Template-Assisted Microdroplet Chemistry: A Green Route to Nanoparticle Synthesis at Ambient Conditions. **S. Paul**, A. Berbille, J. E. Dick. (filed)

SELECT PUBLICATIONS (4 OF 14) [Google Scholar](#)

- S. Paul**, A. Berbille, M. A. Faisal, et al. Ambient, Bias-Free, Green Nanoparticle Synthesis via Microdroplet-Confined Galvanic Chemistry. ***Small*** (2026)
- S. Paul**, J. H. Nguyen et al. Standardizing non-electrode coin cell components in aqueous zinc battery research. ***EES Batteries***, 2025, 1, 813–823. (**Front Cover; Top 10% Hot Article**)
- A. Rana*, **S. Paul*** et al. Interfacial pH Gradients Explain High Coulombic Efficiency at High Current Densities for Zinc Metal Batteries. ***Joule***, 2025 (accepted). *equal contribution (first author)
- MA Faisal, T Liu, A Rana, JH Nguyen, **S Paul** et al. Slowing Down Zinc Electrodeposition Kinetics Can Maximize and Compromise Anode Stability: How Slow Is Too Slow? ***Angewandte Chemie International***, 2026.

HONORS, AWARDS & PRESENTATIONS

- Purdue News:** First Author Publication in Joule. “Interfacial pH gradients responsible for Better Zn Batteries”.
- Accepted **Semiconductor Talk** “Autonomous Cu Electrodeposition in Microelectronics” (MRS, ECS 2026)
- Best Poster Prize**, Birck Nanotechnology Annual Symposium, Purdue University (2025)
- Journal Front Cover & Top 10% “Hot Article” Selection**, EES Batteries (2025)
- Invited lectures** at North Carolina State University and Purdue Electron Microscopy Day (2025)
- All India Exam: IIT-JAM National Chemistry Entrance Exam (2019): Rank 72 out of 15731. (99.54 percentile)