

# Zainul Aabdin, PhD

Senior Scientist, Advanced Nanoanalysis Lab

Institute of Materials Research and Engineering (IMRE)

Agency for Science Technology and Research (A\*STAR), Singapore

 [Google Scholar](#)  [LinkedIn](#)  [zainul.aabdin@gmail.com](mailto:zainul.aabdin@gmail.com)

## PROFESSIONAL SUMMARY

---

Accomplished Materials Scientist with over a decade of expertise in advanced transmission electron microscopy (TEM) including in-situ TEM techniques, and nanofabrication processes. Established leader with a proven track record of securing S\$1.4M in competitive research grants and mentoring graduate students. Published 75+ research articles, many in top-tier journals, and delivered invited talks at international conferences. Proficient in integrating research with teaching, and skilled in fostering collaborations across academia and industry. Experienced in microscopy image/video segmentation, analysis, and the application of AI/ML techniques to enhance data-driven insights.

## ACADEMIC QUALIFICATIONS

---

- **Doctor of Philosophy (PhD) in Applied Physics**  
University of Tübingen, Germany (2009 – 2013)  
Dissertation: *Structural Characterization and Structure-property Correlation of Nanostructured Superconducting Coated Conductors and Thermoelectric Materials*
- **Master of Technology (MTech) in Materials Science**  
Indian Institute of Technology (IIT) Kanpur, India (2005 – 2008)  
Dissertation: *Nano Electrode Fabrication using Focused Ion Beam (FIB) suitable for Organic Devices*
- **Master of Science (MSc) in Physics**  
University of Allahabad, India (2001 – 2004)
- **Bachelor of Science (BSc) in Physics and Mathematics**  
Ewing Christian College, Allahabad, India (1998 – 2001)

## HONORS AND AWARDS

---

- National Research Foundation (NRF), Singapore (2021) – Competitive research grant awarded S\$786K for 4 years.
- Career Development Award (CDA), Singapore (2020) – Competitive research grant awarded S\$600K for 3 years.
- Best Poster Award (2021) – Materials Research Society (MRS), Singapore.
- Academic Excellence Award (2007) – Indian Institute of Technology (IIT) Kanpur, India.
- Graduate Aptitude Test in Engineering (GATE) Fellowship, India (2005) – Ranked in the top 1% nationally in Physics.
- JRF/SRF Fellowship – Qualified National Eligibility Test (NET) for Lectureship, CSIR-UGC, India (2005) – Ranked in the top 20% nationally

## EMPLOYMENT HISTORY

---

### **Research Scientist and Group Leader (2017 – Present)**

Institute of Materials Research and Engineering (IMRE), A\*STAR, Singapore

- Secured and managed S\$1.4M in research funding as PI for cutting-edge projects on scalable interconnects and nanofabrication.
- Led a team of 4 scientists and mentored multiple graduate students.
- Provided technical guidance and career development support to junior researchers.
- Designed custom in-situ TEM holders for advanced wetting, drying, and etching studies.
- Developed nanoscale cyclic etching technique for next-generation microelectronics.
- Pioneered modular systems for nanoparticle templating.

### **Postdoctoral Research Fellow (2013 – 2017)**

National University of Singapore (NUS), Singapore

- Conducted groundbreaking research on interfacial water technologies and nanocrystal welding using in-situ TEM.
- Designed innovative liquid-cell TEM holders and automated data acquisition workflows using Digital Micrograph scripting.
- Collaborated with industry partners and academic institutions to advance device fabrication techniques.

## TEACHING EXPERIENCE

---

- Supervised 5+ final year students, providing guidance on experimental design, data analysis, report writing, and manuscript preparation.
- Trained internal and external microscopy users for independent operations.
- Organized advanced electron microscopy workshops for students and guest researchers.

## SELECTED TALKS

---

### **SEMICON Korea 2024, COEX, Seoul, Korea (invited)**

*Presentation Title: Liquid phase transmission electron microscopy for imaging wetting and drying phenomena in vertical nanostructures*

### **3<sup>rd</sup> International Conference on Advanced Surface Enhancement (INCASE-2023), Singapore (invited)**

*Presentation Title: Controlled cyclic etching of next-generation metal interconnects line*

### **1<sup>st</sup> International Conference on Recent Advances in Nanoscience and Nanotechnology (ICRANN-2014), New Delhi (invited)**

*Presentation Title: Bonding pathways of gold nanocrystals in solution*

### **16th International Symposium on Ultra Clean Processing of Semiconductor Surfaces (UCPSS-2023), Brugge, Belgium**

*Presentation Title: An Observation of Capillary Condensation and Pattern Bending Phenomena in Si Nanopillars using In-situ TEM*

## TECHNICAL SKILLS

---

### Electron Microscopy

- Experienced with Thermo Fisher Scientific (Spectra 300, Titan, Talos, Tecnai G2) and JEOL (2010, 2100) TEMs
- Expertise in advanced EM techniques (STEM, iDPC, 4D-STEM, EELS, EDX, tomography)
- Proficient in diffraction techniques (ED, CBED, NanoMEGAS PED)
- Liquid- and gas-phase in-situ TEM
- Hands-on experience in cryo-EM, SEM, and AFM.

### TEM Sample Preparation

- Conventional polishing, ion-milling
- Custom liquid-cell fabrication for in-situ TEM
- Focused Ion Beam (FIB) lamella preparation

### Device Fabrication

- Photomask design (L-Edit), photolithography, micropatterning
- Dry plasma and wet chemical etching
- Thin-film deposition – ALD, Thermal Evaporation, Spin Coating, Dip Coating

### Software and Programming

- Python (image segmentation, data analysis, visualization)
- AI/ML applications in materials science
- Digital Micrograph (DM) scripting, ImageJ scripting (JavaScript)
- SolidWorks (Certified), Fusion 360 (CAD modeling)
- LabVIEW, Arduino, Microsoft Visual Studio (C#, Kotlin)
- Graphic Design (Adobe Illustrator, After Effects, and Premier Pro)

## PROFESIONAL TRAINING

---

### Grant Writing and Research Funding

- Masterclass on Pre- and Post-Submission Strategies
- Introduction of Grant Writing
- Ins and Outs of Grant Writing
- Writing Effective Grant Proposals

### Project and Performance Management

- Project Management Foundational Program
- A\*STAR Managerial Development Program
- Effective Project Management
- Performance Management
- Effective Communications and Leadership
- Facilitating Meetings that Matter: Energizing People, Achieving Outcomes
- Workshop on Conducting Career Development Conversation
- Workshop on Managing Professional Boundaries (MPB) for Managers

### Technical Workshops

- Machine Learning Basics
- SolidWorks Essentials Certification

## ACADEMIC SERVICE

---

- Reviewed over 35 articles for Scientific Journals
- Contributed to organizing an international conference

## PATENTS

---

1. [System and method for controlling directionality of fast-wet etching of crystalline silicon, c-Si](#)  
**Z. Aabdin**, T. Ghosh, F. Holsteyns, A. Pacco, M. Bosman, U. Mirsaidov  
Granted US Patent 11906946 (**2022**)
2. [Spectroscopy system for blood and/or tissue monitoring](#)  
K. Lin, W. Xizu, S.W.Q. Yang, Z. Qiang, **Z. Aabdin**  
SG Provisional Patent (**2025**)

## SELECTED PUBLICATIONS

---

1. [Controlled stepwise wet etching of polycrystalline Mo nanowires](#)  
K. Saidov, I. Erofeev, **Z. Aabdin**, A. Pacco, H. Philipsen, A. W. Hartanto, Y. Chen, H. Yan, W. W. Tjiu, F. Holsteyns, U. Mirsaidov  
*Advanced Functional Materials*, 34(12), 2310838 (**2024**)
2. [Thermoelectric property enhancement of tellurium nanowires by surface passivation](#)  
S. Z. H. Shah, **Z. Aabdin**, W. W. Tjiu, W. Nong, J. Recatala-Gomez, V. Chellappan, W. Zhai, D. V. M. Repaka, G. Wu, K. Hippalgaonkar, I. Nandhakumar, P. Kumar  
*ACS Applied Materials & Interfaces*, 16(35), 46191 (**2024**)
3. [Oxygen plasma induced nanochannels for creating bimetallic hollow nanocrystals](#)  
W. Y. Wu, S. Wu, W. W. Tjiu, H.R. Tan, F. Y. Leong, P. C. Lim, S. Wang, W. Jiang, R. Ji, Q. Zhu, M. Bosman, Q. Yan, and **Z. Aabdin**  
*ACS Nano*, 17(17), 17536 (**2023**)
4. [A rapid total bacteria count method using nanoparticle conjugated with aptamer for water quality](#)  
L. Sutarlie, H. L. Chee, S. Y. Ow, **Z. Aabdin**, W. W. Tjiu, X. Su  
*Nanoscale*, 15(41), 16675 (**2023**)
5. [Patterning at the resolution limit of commercial electron beam lithography](#)  
M. S. Saifullah, M. Asbahi, D. C. Neo, Z. Mahfoud, H. R. Tan, S. T. Ha, N. Dwivedi, T. Dutta, S. bin Dolmanan, **Z. Aabdin**, M. Bosman, R. Ganesan, S. Tripathy, D. G. Hasko, S. Valiyaveetil  
*Nano Letters*, 22, 7432 (**2022**)
6. [Controlling the wet-etch directionality in nanostructured silicon](#)  
**Z. Aabdin**, T. Ghosh, A. Pacco, S. Raj, H. T. B. Do, K. Saidov, T. W. Weei, U. Anand, P. Kral, F. Holsteyns, M. Bosman, U. Mirsaidov  
*ACS Applied Electronic Materials*, 4, 5191 (**2022**)
7. [Deep learning-based high throughput inspection in 3D nanofabrication and defect reversal in nanopillar arrays: Implications for next generation transistors](#)  
U. Anand, T. Ghosh, **Z. Aabdin**, N. Vrancken, H. Yan, X. Xu, F. Holsteyns, U. Mirsaidov  
*ACS Applied Nano Materials*, 4, 2664 (**2021**)
8. [High-efficiency, single-crystalline, p-and n-type Si solar cells: Microstructure and chemical analysis of the glass layer](#)  
P. Kumar, **Z. Aabdin**, M. Pfeffer, O. Eibl  
*Solar Energy Materials and Solar Cells*, 178, 52 (**2018**)
9. [Transient clustering of reaction intermediates during wet etching of silicon nanostructures](#)  
**Z. Aabdin**, X. M. Xu, S. Sen, U. Anand, P. Král, F. Holsteyns, U. Mirsaidov  
*Nano Letters*, 17, 2953 (**2017**)
10. [Hydration layer-mediated pairwise interaction of nanoparticles](#)  
U. Anand, J. Lu, D. Loh, **Z. Aabdin**, U. Mirsaidov  
*Nano Letters*, 16, 786 (**2016**)
11. [Bonding pathways of gold nanocrystals in solution](#)  
**Z. Aabdin**, J. Lu, X. Zhu, U. Anand, N. D. Loh, H. Su, U. Mirsaidov  
*Nano Letters*, 14, 6639 (**2014**)
12. [Switching of the natural nanostructure in Bi<sub>2</sub>Te<sub>3</sub> materials by ion irradiation](#)

**Z. Aabdin**, N. Peranio, O. Eibl  
*Advanced Materials*, 24, 4605 (2012)

13. Growth behavior of superconducting  $\text{DyBa}_2\text{Cu}_3\text{O}_{7-x}$  thin films deposited by inclined substrate deposition for coated conductors

**Z. Aabdin**, M. Dürschnabel, M. Bauer, R. Semerad, W. Prusseit, O. Eibl  
*Acta Materialia*, 60, 6592 (2012)

## REFERENCES

---

### **Prof. Oliver Eibl**

Institute of Solid State Physics, TU Wien

✉ [email@tuwien.ac.at](mailto:email@tuwien.ac.at) (available on request)

PhD Supervisor, University of Tübingen, Germany

### **Assoc. Prof. Utkur Mirsaidov**

National University of Singapore (NUS), Singapore

✉ [email@nus.edu.sg](mailto:email@nus.edu.sg) (available on request)

Postdoctoral Supervisor, NUS, Singapore.

### **Assoc. Prof. Michel Bosman**

National University of Singapore (NUS), Singapore

✉ [email@nus.edu.sg](mailto:email@nus.edu.sg) (available on request)

Mentor and Principal Investigator, IMRE, Singapore.

### **Prof. Yogendra Kumar Mishra**

University of Southern Denmark (SDU), Denmark

✉ [email@mci.sdu.dk](mailto:email@mci.sdu.dk) (available on request)

Collaborator and frequent manuscript review referrals