

Tanbir Sarowar

PH.D. STUDENT · MECHANICAL ENGINEERING

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RESEARCH INTERESTS

Precision metrology and instrumentation for semiconductor manufacturing and advanced packaging. My doctoral research characterizes the silicon wafer-vacuum chuck interface, the reference surface for lithography, etching, and metrology, with non-contact and non-destructive methods: high-speed pattern-projection deflectometry, near-infrared (NIR) reflection spectroscopy, and electrochemical impedance spectroscopy (EIS). I pair these measurements with physics-based models of plate mechanics and squeeze-film flow, and I apply EIS to wafer-level inspection of bonded interfaces for 3D integration. My earlier work combined computational fluid dynamics (CFD) and supervised machine learning to design microfluidic devices for cancer cell separation.

semiconductor metrology · wafer chucking · optical deflectometry · NIR reflection spectroscopy · impedance spectroscopy · bonded-wafer inspection · plate and contact mechanics · machine learning for design

EDUCATION

2025 – 2028
expected

Texas A&M University

College Station, TX

Ph.D. in Mechanical Engineering

Advisor: Dr. ChaBum Lee

Thesis: Characterization and Modelling of Silicon Wafer Chucking Mechanics for Enhanced Critical Dimension

2023 – 2024

Washington State University

Vancouver, WA

M.S. in Mechanical Engineering · GPA 3.91/4.00

Advisor: Dr. Xiaolin Chen

Thesis: Predictive Modeling in Cancer Cell Separation: A Machine Learning Approach in DLD Devices

2017 – 2021

Islamic University of Technology

Gazipur, Bangladesh

B.S. in Mechanical Engineering · GPA 3.77/4.00 · top 10% of class

Undergraduate research: numerical heat transfer in liquid-metal-cooled micro- and minichannel heat sinks with ceramic substrates

RESEARCH EXPERIENCE

2025 – present

Texas A&M University

College Station, TX

Graduate Research Assistant, Precision Metrology & Instrumentation Group

Advisor: Dr. ChaBum Lee

Wafer-chuck interface metrology (dissertation research)

Measures the air gap and contact state between a 300 mm wafer and its vacuum chuck.

- *Introduced EIS as a non-destructive probe of the wafer-chuck interface, using a magnetic ball-ended probe and an equivalent-circuit model of the contact, wafer, and air-gap impedances.*
- *Measured vacuum-induced gap closure by NIR reflection spectroscopy with Fabry–Pérot fringe analysis, resolving a 10–15 μm gap reduction that varies across the wafer, validated with a capacitive displacement sensor.*

High-speed deflectometry of wafer chucking

Maps full-wafer shape and the chucking transient by non-contact reflection deflectometry.

- *Designed and built a dot-pattern (pattern-projection) deflectometry system for 300 mm wafers on vacuum chucks, with a Python/OpenCV pipeline for camera and homography calibration, sub-pixel dot localization, tilt-sensitivity calibration, and slope-to-height reconstruction.*
- *Developed a flip and rotation-reversal decomposition that separates gravity sag, intrinsic wafer warpage, and chuck systematic error in on-chuck height maps, and showed that the chuck error sets the peak on-chuck deformation.*
- *Extended the system to 2,100 frames per second to resolve the full-wafer chucking transient: seating is an overdamped elastohydrodynamic relaxation whose rate is set by the wafer-chuck seal and modulated by the wafer's back-surface film.*

Non-destructive inspection of bonded wafers by EIS

Wafer-level assessment of bond quality for 3D integration, with industry partner Samsung Electronics.

- *Characterized 300 mm SiCN-bonded wafers with a ball-to-rod magnetic-probe EIS system over 10 Hz–100 MHz, mapping bond quality on 7×7 grids and a 37-point polar sampling scheme.*
- *Quantified annealing-driven bond improvement: interfacial resistance fell from a non-uniform 2–3 $\text{M}\Omega$ to about 1 $\text{M}\Omega$, tracking the reference bonding energy; bond quality declined from the wafer center (about 0.34 $\text{M}\Omega$) toward the edge (about 1.2 $\text{M}\Omega$).*
- *Located high-impedance sites as candidate voids and particles and confirmed them by NIR imaging, supporting a two-stage inspection strategy of global screening followed by local high-resolution mapping.*

2023 – 2024

Washington State University

Vancouver, WA

Graduate Research Assistant, School of Engineering and Computer Science

Advisor: Dr. Xiaolin Chen

ML-guided design of microfluidic DLD devices (M.S. thesis)*Deterministic lateral displacement (DLD) device design with CFD-trained surrogate models.*

- *Generated validated COMSOL CFD particle-tracking datasets for DLD arrays, up to 8.9 million trajectory points spanning array periods $N = 3\text{--}48$ and particle diameters of $1\text{--}20\text{ }\mu\text{m}$, verified by grid-independence and analytical velocity-profile checks.*
- *Trained surrogate models (random forest, gradient boosting, k-nearest neighbors, multilayer perceptron) to predict particle trajectories and the critical diameter; random forest reached a test R^2 of 0.994 and a $0.31\text{ }\mu\text{m}$ mean absolute error in critical diameter.*
- *Applied the surrogates to colorectal circulating tumor cell (CTC) separation: the workflow converged on an optimal array ($N = 15$, critical diameter $10\text{--}12\text{ }\mu\text{m}$) in 2.3 s, over four orders of magnitude faster than equivalent CFD iteration, and a targeted CFD simulation confirmed the design.*

DEP-assisted inertial microfluidics for CTC separation

- *Built numerical models of dielectrophoresis (DEP)-assisted inertial microfluidic separation of CTCs from blood cells, including curved contraction-expansion microchannels.*
- *The IMECE 2023 paper received the Best Student Article for Global Impact award (MEMS Division).*

INDUSTRY EXPERIENCE

May – Aug 2024

ASML

Hillsboro, OR

Customer Support Engineer Intern

- *Collaborated with the installation team on ASML's next-generation High-NA EUV lithography system within Intel's D1X cleanroom, contributing to a critical phase of the tool's deployment.*
- *Executed module adjustment procedures and qualification tests, analyzing system data to validate hardware performance against nanometer-scale specifications.*

2021 – 2022

Bangla Trac Ltd. (authorized Caterpillar dealer)

Dhaka, Bangladesh

Engineer

- *Led technicians in diagnosing and resolving issues with Caterpillar marine engines.*
- *Conducted on-site troubleshooting and repairs, ensuring minimal downtime.*

PUBLICATIONS

Journal articles

- J1**
2026 **T. Sarowar**, Y. Lim, M. A. Islam, H. Chun, K. Lu, C. B. Lee. "Wafer-vacuum chuck interface characterization by electrochemical impedance spectroscopy." *Vacuum* 249, 115277 (2026). doi:[10.1016/j.vacuum.2026.115277](https://doi.org/10.1016/j.vacuum.2026.115277)
- J2**
2026 C. Kim, H. Chun, **T. Sarowar**, H. Lee, C. B. Lee. "Wafer bonding layer characterization and inspection by electrochemical impedance spectroscopy (EIS)." *Journal of Manufacturing Processes* 165, 349–358 (2026). doi:[10.1016/j.jmapro.2026.03.021](https://doi.org/10.1016/j.jmapro.2026.03.021)
- J3**
2026 **T. Sarowar**, E. Chen, X. Chen. "A CFD-driven supervised learning framework for rapid DLD microfluidic chip optimization in CTC separation." *Biomedical Microdevices* 28(2), 30 (2026). doi:[10.1007/s10544-026-00813-1](https://doi.org/10.1007/s10544-026-00813-1)
- J4**
2026 **T. Sarowar**, S. A. Mim, X. Chen. "Data-driven design of deterministic lateral displacement microfluidic devices for CTC separation." *Biotechnology Progress* 42(4), e88515 (2026). doi:[10.1002/btpr.88515](https://doi.org/10.1002/btpr.88515)
- J5**
2023 M. R. Uddin, **M. T. Sarowar**, X. Chen. "Separation of CTCs from WBCs using DEP-assisted inertial manipulation: A numerical study." *Electrophoresis* 44(23), 1781–1794 (2023). doi:[10.1002/elps.202300090](https://doi.org/10.1002/elps.202300090)
- J6**
2022 Y. Khan, **M. T. Sarowar**, M. Mobarrat, M. H. Rahman. "Performance comparison of a microchannel heat sink using different nano-liquid metal fluid coolant: A numerical study." *ASME Journal of Thermal Science and Engineering Applications* 14(9), 091014 (2022). doi:[10.1115/1.4054007](https://doi.org/10.1115/1.4054007)
- J7**
2022 A. Abid, **M. T. Sarowar**. "Heat transfer, thermal stress and failure inspection of a gas turbine compressor stator blade made of five different conventional superalloys and ultra-high-temperature ceramic material: A direct numerical investigation." *Journal of Failure Analysis and Prevention* 22(3), 878–898 (2022). doi:[10.1007/s11668-022-01413-w](https://doi.org/10.1007/s11668-022-01413-w)
- J8**
2021 **M. T. Sarowar**. "Numerical analysis of a liquid metal cooled mini channel heat sink with five different ceramic substrates." *Ceramics International* 47(1), 214–225 (2021). doi:[10.1016/j.ceramint.2020.08.124](https://doi.org/10.1016/j.ceramint.2020.08.124)
- J9**
2021 **M. T. Sarowar**. "Performance comparison of microchannel heat sink using boron-based ceramic materials." *Advanced Materials Research* 1163, 73–88 (2021). doi:[10.4028/www.scientific.net/AMR.1163.73](https://doi.org/10.4028/www.scientific.net/AMR.1163.73)

Peer-reviewed conference papers

- C1**
2026 **T. Sarowar**, Y. Lim, H. Chun, C. B. Lee. "Characterization of silicon wafer geometric conformity on vacuum chucks." *Proc. ASME 2026 21st International Manufacturing Science and Engineering Conference (MSEC2026)*, State College, PA, June 14–18, 2026. Paper MSEC2026-182893.
- C2**
2025 E. Chen, A. Lee, **M. T. Sarowar**, X. Chen. "Data-driven predictive modeling of microfluidic cancer cell separation using a deterministic lateral displacement device." *Proc. 2025 IEEE International Conference on Data Mining Workshops (ICDMW)*, 2709–2715 (2025). doi:[10.1109/ICDMW69685.2025.00347](https://doi.org/10.1109/ICDMW69685.2025.00347)

- C3**
2024 *M. T. Sarowar, M. Mobarrat, X. Chen. "Predictive modelling of microfluidic devices targeting cancer cell separation." Proc. ASME 2024 International Mechanical Engineering Congress and Exposition (IMECE2024), Vol. 10, Portland, OR, November 17–21, 2024. doi:10.1115/IMECE2024-142274*
- C4**
2023 *M. T. Sarowar, M. S. Islam, X. Chen. "Separation of CTCs from blood cells using curved contraction-expansion microchannel equipped with DEP force." Proc. ASME 2023 International Mechanical Engineering Congress and Exposition (IMECE2023), Vol. 12, New Orleans, LA, October 29 – November 2, 2023. doi:10.1115/IMECE2023-112803
Best Student Article for Global Impact, MEMS Division*

CONFERENCE PRESENTATIONS

- Jun 2026 *"Characterization of silicon wafer geometric conformity on vacuum chucks." ASME 21st International Manufacturing Science and Engineering Conference (MSEC 2026), State College, PA.*
- Feb 2026 *"Non-destructive quality assessment of bonded wafers using electrochemical impedance spectroscopy." Texas Society for Microscopy (TSM) 60th Anniversary Meeting, The University of Texas at Austin, Austin, TX.*
- Oct 2023 *"Separation of CTCs from blood cells using curved contraction-expansion microchannel equipped with DEP force." ASME International Mechanical Engineering Congress and Exposition (IMECE 2023), New Orleans, LA.
Best Student Article for Global Impact, MEMS Division*

AWARDS AND HONORS

- 2026 *J. George H. Thompson Graduate Fellowship, J. Mike Walker '66 Department of Mechanical Engineering, Texas A&M University*
- 2023 *Best Student Article for Global Impact, MEMS Division, ASME IMECE 2023*

References available on request.