

Vikhram Vilasur Swaminathan

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Education

University of Illinois at Urbana-Champaign

Ph.D., Mechanical Engineering (Mavis MF3 Fellowship)

M.S., Mechanical Engineering

Urbana, IL

2015

2011

National Institute of Technology

B.Tech., Mechanical Engineering (Gold Medal & First Class with Distinction Honors)

Tiruchirappalli, India

2006

Interest Areas and Expertise

Semiconductor processing, High Aspect Ratio Etch, Micro-Electro-Mechanical Systems (MEMS), Biosensors, Microfluidics, Nanofluidics, Nanofabrication, Water Purification and Microscale Power Sources.

Skills

Microfabrication: high aspect-ratio dry etch (RIE & DRIE), wet etch, photolithography, evaporation & sputter deposition, electrodeposition, atomic layer deposition, wafer/chip bonding, transfer lithography, MACEtch, PDMS molding.

Characterization: optical/electron microscopy, semiconductor characterization, electrochemistry, thin/thick film measurements, self-assembled monolayers, surface measurements.

Solution Development: Structured problem solving (8D, Pugh methods), SPCs, DOEs, FMEA.

Programming: MATLAB, Origin, JMP, L^AT_EX, GIMP, ImageJ, MS Office

CAE Tools: COMSOL, ABAQUS/CAE, dw-2000, Pro/E, Autodesk Inventor, AutoCAD

Honors and Distinctions

First Place among Oral Presentations at the Applied Materials ETch Conference	2024
Inducted as a Senior Member of the Institute of Electrical and Electronics Engineers, USA	2022
Inducted as a Member of the Royal Society of Chemistry (MRSC), UK	2021
Recognition for Competitive Differentiation: Contributions in High Aspect Ratio Etch, Lam Research Corp.	2019
Spot Awards for Contributions to Lam Core Values, Lam Research Corp.	2016/17/18
Mavis MF3 Fellowship, College of Engineering, UIUC	2011-13
Graduate Teacher Certificate, Center of Teaching Excellence, UIUC	2013
Featured in List of Teachers Ranked Outstanding/Excellent (6 semesters), UIUC	2010-15
Overall Outstanding Student: RECAL Alumni Association Award, NITT	2006
Convocation Gold Medalist in Mechanical Engineering, NITT	2006
Best Outgoing Student in Mechanical Engineering: RECAL Alumni Association Award, NITT	2006
JNCASR Summer Research Fellowship (among 144 students all over India)	2005
Finalist, Indian National Chemistry Olympiad (among top 58 candidates all over India)	2002

Experience

Applied Materials, Inc.

Process Engineer 5 (Senior Staff level) - Etch Products

Process Engineer 4 (Staff level) - Selective Removal Products

Santa Clara, CA, USA

July 2022 - present

September 2020 - July 2022

• Dielectric etch, selective clean/atomic layer etching for DRAM & NAND Memory and Logic applications.

Process engineering R&D and new product introductions to enable semiconductor technology roadmaps.

– Developing novel dielectric etch, highly selective etch and surface clean processes for high-aspect ratio structures.

* Performing fundamental characterization and improvements of early stage dielectric etch tool.

* Demonstrated highly selective and precise 3D NAND deep chop and word-line contact memory etch schemes.

- * Emphasis on high-throughput and versatility to etch semi-critical and back end of line features cost-effectively.
- * Developed a highly selective bit-line contact oxide critical etch to enable N+1/N+2 DRAM technology node.
- * Demonstrated product versatility to etch critical and non-critical features at various steps in device integration.
- Mentored, trained and oversaw junior engineers' for early-stage process development of multiple applications.
- Led the process transfer and ramp-up at high volume fab through strong cross-functional engagements and collaboration with customer and AMAT engineering, process and productivity groups.
- Pathfinding activities for engineering improvements and qualifying new product features to establish new capabilities and competitive differentiation for AMAT Etch and SRP products.
- Researched and characterized novel etch regimes that translate into new IP protection for AMAT products.

Lam Research Corporation

Fremont, CA, USA

Senior Process Engineer - Dielectric Etch

February 2018 - September 2020

Process Engineer - Dielectric Etch

December 2015 - February 2018

- **Dielectric etch for 3D NAND & DRAM.** Process engineering R&D to enable memory technology roadmaps.
 - Developed etch processes to facilitate high-aspect ratio FEOL patterning of dielectric stacks.
 - Facilitated process transfer and ramp-up to production at high volume fab through strong cross-functional engagements and collaboration with customer and Lam's engineering, process, productivity and deposition groups.
 - * Enabled qualification of critical pillar etch process for 2 technology nodes for a 3D NAND etch application.
 - * Demonstrated up to 35% improved throughput for a 3D NAND Slit etch process for 3 technology nodes.
 - * Enabled, via pathfinding, a penetration opportunity in capacitor cell etch business for sub-50nm pitch DRAM nodes.
 - Synthesized data-driven solutions to yield problems through root cause analysis of critical factors.
 - * Implemented statistically robust solutions, with hardware kits and process tuning, for 300mm wafer uniformity.
 - Demonstrated process engineering improvements and new product features to establish new capabilities and competitive differentiation for Lam products.
 - Researched and characterized novel etch regimes that translated into new IP protection for Lam products.

University of Illinois at Urbana-Champaign

Urbana, IL, USA

Postdoctoral Research Associate: Department of Bioengineering

September 2015 - November 2015

Research Assistant: Shannon/Bashir Research Groups

April 2008 - Aug 2015

Graduate Mentor: Illinois Scholars Undergraduate Research (ISUR) Program

August 2009 - May 2010

Instructional Teaching Assistant: Mechanical Science and Engineering

May - August 2012

Teaching Assistant: Laboratory, tutoring and grading

(10 semesters) August 2007 - May 2015

- **Label-free sensing using FET biosensors.** Adapted deionization techniques to overcome Debye screening of FETs.
 - Developed a *transistor-in-droplet* framework for high-throughput, multiplexed detection of biomarkers using FETs.
 - * One of the first demonstrations of multiplexing & large statistical measurements with (*million-pixel*) FET biosensors.
 - Fabricated and extensively characterized nanotextured microelectrodes for simultaneous desalting and sensing.
 - * Adapted analytical models for double-layer screening of highly saline media, with experimental validation and surface treatment of the microelectrodes to maximize desalting performance.
 - * Demonstrated a novel capability to bias a FET sensor using the microelectrodes during desalting.
 - Collaborated with a diagnostics major and a semiconductor foundry. Secured patent applications.
- **Microfluidic separation of sub-micron colloids.** Developed electrostatic methods for enhanced dielectrophoresis.
 - Microfabricated high aspect-ratio interdigitated electrode arrays to capture colloidal nanoparticles in microchannels.
 - Simulated and experimentally verified the enhanced separation effects of mixed AC/DC dielectrophoresis.
 - Demonstrated multiple schemes to capture nanoparticles based on salinity for upstream use in reverse osmosis systems.
- **Hierarchical nanostructures in silicon.** Nanofabricated structures with tunable surface geometry and hierarchy.
 - Developed a one-mask microfabrication flow to etch re-entrant features with out-of-plane nanopillars in silicon.
 - Demonstrated an extremely hydrophobic surface with $\sim 171^\circ$ water contact angle and $< 1^\circ$ sliding angle.
- **Fuel cell PowerMEMS.** Integrated hydrogen sources and fuel cells into a PowerMEMS using microfabrication methods.
 - Designed, fabricated & characterized a prototype micro fuel cell passive with microfluidic self-regulation scheme.
 - Demonstrated ultra-high capacity of 200 Whr/L energy density and > 300 W/L power density.
 - * One of the world's smallest Fuel Cells, and the highest energy/power density demonstration of a PowerMEMS.

Indian Institute of Science

Bangalore, India

JNCASR Summer Research Fellow and Project Assistant

May - July 2005, October - December 2006

- **Compliant MEMS synthesis.** Designed a bistable MEMS switch using four-bar mechanisms, torsional joints & electro-thermal-compliant (ETC) microactuators, and simulated their coupled mechanics using ABAQUS finite element analysis to synthesize optimized prototype structures.

Patent Publications

1. R. Bashir, **V.V. Swaminathan**, B. Reddy, Jr., E. Salm & C. Duarte-Guevara, “Label Free Analyte Detection by Electronic Desalting and Field Effect Transistors”, US Patent #10,527,579, USPTO, issued 7 Jan. 2020.
2. N. Dole, **V.V. Swaminathan**, B. Jiang & M. Wong, “Multi-state rf pulsing to control mask shape and breaking selectivity versus process margin trade-off”, US Application #2022-0285130 A1, USPTO, filed 2019 (patent pending).

Book Chapters

1. N. Dole et al., “Corona Treatment of Polymer Surfaces to Enhance Adhesion”, Polymer Surface Modification to Enhance Adhesion: Techniques and Applications: K.L. Mittal & A. Netravali (eds.), Scrivener Publishing (Wiley), USA, 2024.
2. D.P.R. Thanu et al., “Use of Surfactants in Acoustic Cleaning”, Surfactants in Precision Cleaning: Removal of Contaminants at the Micro and Nanoscale: R. Kohli & K.L. Mittal (eds.), Elsevier, Netherlands, 2021.
3. **V.V. Swaminathan** et al., “Ionic Transport in Nanocapillary Membrane Systems”, Nanotechnology for Sustainable Development: M.S. Diallo, N.A. Fromer, M.S. Jhon (eds.), Springer International Publishing, Switzerland, 2014.

Selected Journal Publications

1. **V.V. Swaminathan** et al., “Electronic desalting for controlling the ionic environment in droplet-based biosensing platforms”, *Applied Physics Letters*, vol. 106, 2015, pp. 053105.
2. **V.V. Swaminathan** et al., “Enhanced sub-micron colloidal particle separation with interdigitated microelectrode arrays using mixed AC/DC dielectrophoretic scheme”, *Biomedical Microdevices*, vol. 17, 2015, pp. 29.
3. H. Hu, **V.V. Swaminathan** et al., “Hierarchically Structured Re-entrant Microstructures for Superhydrophobic Surfaces with Extremely Low Hysteresis”, *Journal of Micromechanics and Microengineering*, vol. 24, 2014, 095023 (co-first author).
4. **V.V. Swaminathan** et al., “Ionic Transport in Nanocapillary Membrane Systems”, *Journal of Nanoparticle Research: special issue on Nanotechnology for Sustainable Development*, vol. 14, 2012, pp. 951-65.
5. **V.V. Swaminathan** et al., “Integrated micro fuel cell with on-demand hydrogen production and passive control MEMS”, *Microfluidics & Nanofluidics*, vol.12, 2012, pp. 735-49.
6. C. Duarte-Guevara, **V.V. Swaminathan** et al., “Characterization of a 1024 x 1024 DG-BioFET platform”, *Sensors and Actuators B: Chemical*, vol. 250, 2017, pp. 100-110.

Service and Leadership

- Memberships in Professional and Scientific Societies: IEEE and RSC.
- Peer reviewer for AIP Advances Journal and The Journal of Sol-Gel Science and Technology.
- Finisher at the Chicago Full Marathon, raised funds for Asha for Education charity, 2009.
Team Asha Marathon Coordinator for Asha Urbana-Champaign Chapter, 2010-12.
- President of *Balls By Picasso*, the English Literary Society of NITT, 2005-06.
Literary Championships representing NITT at IIMB and JIPMER.
- Editor-in-Chief of Mechanical Engineering Department, 2005-06, NITT.