SHANTANU KALLAKURI

+1-6072162577 | 1249 Lakeside drive, Apt. 1050, Sunnyvale, CA 94085 | shantanuk100@gmail.com | sk3269@cornell.edu
https://www.chemystery.org/ | Google scholar | https://linkedin.com/in/shantkall

Education

Cornell University — Ithaca, NY
M.S. with Thesis in Materials Science and Engineering — *Aug. 2018 – May 2021*

- Advisors: Prof. Richard Robinson and Prof. Tobias Hanrath
- Thesis: *'Development of multiscale hierarchical structures from nanocluster mesophases'* (10.7298/x221-2n24)
- Honors: Graduated with MS thesis, a co-op, patents, and a publication; CGPA: 3.84/4

Birla Institute of Technology & Science (BITS) Pilani — Pilani, India
Dual degree - B.E. in Chemical Engineering and M.Sc. in Chemistry — *Aug. 2010 – Jul. 2015*

- Advisor: Prof. Gokulnath Sabapathi, IICT (Indian Institute of Chemical Technology) (now at IISER-TVM)
- Thesis: *'Bi-conjugated Porphyrin and Sapphyrin macro-cycles for Dye-sensitized solar cells'*
- Honors: Graduated with Honors in both degrees & Dept. rank 3 in Chemical engineering; Major GPA: 9.11/10

Research Experience

Applied Materials Inc. — Santa Clara, CA
Senior Process Engineer, Atomic Layer Deposition Group, Semiconductor Products Group — *Aug. 2021 – Present*

- Process owner for Olympia - Applied's primary line of Plasma-enhanced atomic layer deposition (PE-ALD) machines developing process & chemistry for emergent Gate-all-around (GAA) transistors
- Spearheading a 7 member team to develop plasma-based conformal film deposition of dielectrics for fill & liner applications in advanced-node logic & memory GAA processes and their integration (n+2, sub-1.5nm & beyond)
- Executed multiple IP-protected projects in this role leading to multi-million dollar sales for Applied Materials product for various logic and memory customers. Filed 6 technology patents (Four granted, others pending)

Process Engineering Co-op (Mid-degree), Varian division, Applied Materials (MA) — *Sept. 2019 – Sept. 2020*

- Developed, executed, and patented plasma-enhanced deposition & etch processes for the two applications below. Honored with an *AMAT excellence award* for performance during the internship.

  1) Two plasma-enhanced chemical vapor deposition (PECVD) & one reactive-ion etch (RIE) processes to deposit and etch AR/VR waveguides using plasma gradient & grayscale methods for nanotopographic patterning and

  2) A PECVD processes for directional seeding and seam-free selective deposition of metal on Silicon and mixed Silicon substrates in Buried word-line (BWL) DRAM applications

Cornell University — Ithaca, NY
Graduate Thesis (Advisor: Prof. Richard Robinson), Materials Science & Engineering — *Aug. 2018 – May 2021*

- Pioneered a one-pot synthesis of functional quantum dot magic-sized nanocrystals (MSNC) that hierarchically self-assemble into 99.9% pure, 6% monodisperse thin-films & fibers through a DNA-like biomimetic mesophase
- Developed and assembled novel chiral quantum dots using this system that are electrically and magnetically tunable. These dots are scalable across 7 orders of magnitude (nm-cm), support diverse chemical modifications, and can be easily analyzed using simple laser diffraction techniques. Published this research in *Nature Materials*

Brigham & Women's Hospital, Harvard-MIT HST — Cambridge, MA
Research assistant (Advisor: Prof. Hadi Shafiee), Engineering for medicine — *Aug. 2016 – Feb. 2017*

- Synthesized & surface-modified Janus Pt/Au nanomotors using Thiol cross-linking chemistry, Polymerase chain-reaction (PCR), Loop-mediated (LAMP) DNA amplification to spontaneously bind the nanomotors to pathogen DNA. Achieved 99% accurate HIV/Zika diagnosis by quantifying free vs bound motor velocity using a cellphone
- Published this research in *ACS Nano* & *Nature Communications*

Indian Institute of Chemical Technology — Hyderabad, India
UG Thesis (Advisor: Prof. Gokulnath Sabapathi), Polymers & Functional Materials — *Jan. 2015 – Jul. 2015*

- Designed and synthesized a light-harvesting push-pull expanded *Porphyrin* (*Sapphyrin*) and characterized it using electrochemical impedance spectroscopy (EIS) for Dye-sensitized solar cells (DSSC)
- Iterated through multiple pathways to successfully develop a high-yield solution based on *Thieno− pyrrole* (80%). The novelty was the donor-Pi bridge-acceptor dye which integrates usually disparate electronic regions
- Integrated the dye with a TiO_2 scaffold and *Carbon*, *Indium Tin Oxide* (*ITO*) counter-electrode to build a working cell. Achieved the objective for a dye with broad Q, Soret bands to allow high-efficiency DSSC (10.3%)

Certifications

Stanford: *Harnessing the Power of AI/ML to Address New Engineering Challenges*: Comprehensive 15-week course

Skills

Advanced synthesis: ***nanoparticles*** - quantum-dots, spinel & core-shell nanoparticles; ***self-assembly*** - directed, hierarchical, amphiphilic; ***Thin-films & nanopatterning***; ***Conjugated systems*** - donor-acceptor systems, conductive polymers, Porphyrins; *Surface modification* - Thio/Azo chemistry, ligand functionalization, trap-states
Thin-film growth: PE-ALD, PE-CVD, ALE, selective deposition/etch, directional deposition/etch, RIE, SIMS
Characterization: UV-Vis, XRD, NMR, FTIR, SAXS, OES, Ellipsometry, SRIM, EIS, Optical diffraction
Simulation & modelling: LAMMPS, GAMESS (Basic), Blender, Cinema4D, Solidworks, AutoCAD, Ansys Fluent
ML & AI: Convolutional neural networks, support vector regression, logistic & linear regression, kNNs, decision trees
Programming: Python (proficient), Java (proficient), MatLab, C/C++, VBA, SQL, JavaScript, HTML/CSS
Statistics: Pandas, NumPy, Scikit-learn, Tensorflow, SciPy, Seaborn, Matplotlib, SAS (JMP), DOE

Selected Publications & Conferences

AIx conference, Applied Materials (2024) : "*Detect or defect: A CNN-powered AI-driven approach to semiconductor defect classification*" S. Kallakuri, Z. Zhang, R. Patil, L. Sun, M. Copic

Nature Materials, 21(5): 518-525 (2022) : "*Multiscale hierarchical structures from a nanocluster mesophase*" H. Han, **S. Kallakuri**, Y. Yao, C. B. Williamson, D. R. Nevers, B. H. Savitzky, R. S. Skye, M. Xu, O. Voznyy, J. Dshemuchadse, L. F. Kourkoutis, S. J. Weinstein, T. Hanrath, R. D. Robinson

Nature Communications, 9(1): 4282 (2018) : "*DNA-engineered micromotors powered by metal nanoparticles for motion-based cellphone diagnostics*" M. S. Draz, K. M. Kochehbyoki, A. Vasan, D. Battalapalli, A. Sreeram, M. K. Kanakasabapathy, **S. Kallakuri**, A. Tsibris, D. R. Kuritzkes, H. Shafiee

ACS Nano, 12(6): 5709-5718 (2018) : "*Motion-based immunological detection of Zika Virus using Pt-nanomotors and a cellphone*" M. S. Draz, N. K. Lakshminaraasimulu, S. Krishnakumar, D. Battalapalli, A. Vasan, M. K. Kanakasabapathy, A. Sreeram, **S. Kallakuri**, P. Thirumalaraju, Y. Li, S. Hua, X. G. Yu, D. R. Kuritzkes, H. Shafiee

Functionalized engineering materials & their applications, 1(1):117-124 (2016) : "*Synthesis and characterization of templated Polyanilines: A new class of polymeric materials*" J. Avusula, **S. Kallakuri**, S. Jayanty

Selected Patents

US11956978B2 and US20240040808A1 | *Techniques & devices using directional seeding & selective deposition (2024)*
M. Zeeshan, K. Chan, **S. Kallakuri**, S. Varghese. IP describing selective, angular deposition of dielectrics & metals

US11749564B2 | *Techniques for void-free material depositions (2023)*
M. Zeeshan, K. Chan, **S. Kallakuri**, S. Varghese, J. Hautala. This IP covers a foundational way to deposit metal in void-free manner for Buried Wordline (BWL) DRAM application in advanced transistors since voids raise resistance

US11404314B2 | *Metal line patterning (2022)*
S. Varghese, M. Zeeshan, **S. Kallakuri**, K. Chan. This method describes a process-flow for selective fin patterning through deposition + etch using Plasma-enhanced CVD and/or ALD for transistor Wordline and Bitline application

US20220100078A1 | *Devices and methods for variable etch depths (Submitted, Pending)*
M. Zeeshan, R. Bandy, P. Kurunczi, **S. Kallakuri**, T. Soldi, J. Olson. This IP covers a process-flow crucial to plasma etch process of waveguides and gratings on special glass (Various glass types) for augmented reality (AR) applications

US20220119955A1 | *Techniques for variable deposition profiles (Submitted, Pending)*
M. Zeeshan, **S. Kallakuri**, J. Olson. This IP describes etch techniques to modulate refractive index for AR gratings

Scholastic Achievements and Awards

(2020) ***Applied Materials internship excellence award*** & cash prize **| (2014-2015)** ***T.I.M.E*** undergraduate engineering & management scholarship **| (2013-2015)** ***BITS Pilani MCN*** (merit cum need) undergraduate scholarship **| (2015)** ***Three Bronze*** and ***Two Gold*** medals for university in Carrom and Soccer at national sports fests BOSM, SPREE, and ARENA **| (2014)** ***Runner-up in National selection*** for Carom from Andhra Pradesh

Teaching and Mentorship

- *Teaching assistant*: **(2020) MSE5860** - *Atomic structure*, Prof. Richard Robinson **| (2020) ENGRG1160** - *Intro to Engineering*: Prof. Bruce Van Dover **| (2018) MSE4330** - *Energy materials*, Prof. Richard Robinson
- Mentored 4 batches of 7th-10th grade students as an *Expanding your horizons (EYH)* student engineering mentor
- Taught and mentored 32 undergraduates in Chemistry and Physics on Chegg/InstaEdu over the course of 3 years

Leadership & Outreach

- *Project coordinator, Asha*: Raised over $18000 in fund-raiser events (through concerts, workshops, and student-cooked dinners) for the non-profit, focused primarily on less privileged students in rural India
- *Artist Liaison, Spicmacay*: Organized 8 fund-raising concerts for the non-profit to help popularize Indian Carnatic & Hindustani music through artistes like Sikkil Gurucharan & Pt. Ronu Majumdar
- *Community outreach lead, Yuva (Youth under visionary action) & Nirmaan*: Organized over 6 summer education camps for 8th-10th grade students in Thimmapur & Dasarigudem villages focused on math and science education
- *Event planner, Make a Difference (MAD)*: Regularly organize blood-donation drives (3+) & vaccine camps (2+)