

SHANTANU KALLAKURI

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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 thesis, 1 co-op, 6 patents, and 1 publication; CGPA: 3.9/4

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: 9.1/10

RESEARCH EXPERIENCE

Applied Materials Inc.

Santa Clara, CA

Senior Process Engineer, Semiconductor Products Group

Sept. 2021 – Present

- Process owner for *Olympia* - AMAT's primary line of Plasma-enhanced atomic layer deposition (PE-ALD) machines developing process & chemistry for Gate-all-around (GAA) transistors
- Spearheading a team of 7 members to develop plasma-based conformal film deposition of Si_3N_4 and SiO_2 for gap-fill and liner applications in advanced-node logic & memory GAA-integration (n+2, sub-1nm & beyond)
- Executed multiple IP-protected projects in this role leading to 8-figure dollar sales for Applied Materials product for multiple Logic, DRAM, & NAND customers, and filed 3 technology patents (all granted)

Process Engineering Co-op (Mid-degree), Varian division, Applied Materials (MA)

Sept. 2019 – Sept. 2020

- Developed plasma-processes for multiple projects on: 1) Directional seeding and selective seam-free deposition of Tungsten on SiO_2 over Si for Buried word-line (BWL) DRAM application, 2) PECVD & RIE (reactive-ion etch) processes for gradient etch/deposition on proprietary glass for AR/VR waveguides & gratings
- Honored with an AMAT excellence award and secured 3 patents

Cornell University

Ithaca, NY

Graduate Research Assistant, Richard Robinson Lab, 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 novel chiral quantum dots that are also electrically and magnetically tunable. These dots are scalable across 7 orders of magnitude (nm to 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 Medical School

Cambridge, MA

Research Assistant, Hadi Shafiee Lab, Engineering for medicine - Harvard-MIT HST

Aug. 2016 – Feb. 2017

- Designed, and synthesized surface-modified Janus Pt/Au nanomotors through Thiol cross-linking chemistry, polymerase chain reaction (PCR) & loop-mediated (LAMP) DNA amplification to bind them to pathogen DNA
- Harnessed the unique mobilities of various pathogen DNA-bound nanomotors to quantifiably differentiate their velocities vs free motors and make cheap point-of-care microfluidic HIV/Zika diagnostics with 99% accuracy
- Published this research in *ACS Nano* & *Nature Communications*

Indian Institute of Chemical Technology, CSIR

Hyderabad, India

Research assistant, Giribabu Lingamallu Lab, Polymers & Functional Materials Division

Jan. 2015 – Jul. 2015

- Designed, synthesized and characterized a light-harvesting push-pull expanded *Porphyrin* (*Sapphyrin*) using electrochemical impedance spectroscopy (EIS) for Dye-sensitized solar cell (DSSC) photoanodes
- Iterated through multiple challenging pathways to successfully develop a high-yield solution based on *Thieno-pyrrole* (80%). The novelty was the integrated donor-Pi bridge-acceptor dye that is usually disparate molecules
- 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 (CNNs, SVM, trees, RF, classification, regression). Developed a CNN-system for classifying semiconductor defects

SKILLS

Advanced synthesis: *Self-assembly* - hierarchical, directed, lipidic, amphiphilic; *Nanoparticles* - quantum-dot nanocrystals, spinel and core-shell nanoparticles; *Conjugated systems* - Donor-acceptors, conductive polymers, Porphyrins, Lignins; *Surface modification* - Thio/Azo chemistry, ligand functionalization, trap-state reduction
Thin-film growth: PEALD, PECVD, 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. Kochehyoki, 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 | *Techniques and device structure based upon directional seeding and selective deposition (2024)*
M. Zeeshan, K. Chan, **S. Kallakuri**, S. Varghese. IP describing selective, angular deposition of dielectrics & metals
US20240040808A1 | *Techniques & device structure based upon directional seeding and selective deposition (2024)*
S. Varghese, M. Zeeshan, **S. Kallakuri**, K. Chan. Split IP encompassing parts of the above project idea
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 techniques to modulate refractive index for AR/VR gratings

SCHOLASTIC ACHIEVEMENTS AND AWARDS

(2020) **Applied Materials internship excellence award** & cash prize | (2016) **Department rank 3** in UG Chemical engineering program with major GPA of 9.1/10 | (2014-2015) **T.I.M.E** undergraduate engineering & management scholarship | (2013-2015) **BITS Pilani MCN** (merit cum need) undergraduate scholarship (25%) for six consecutive semesters | (2015) **Three-time Bronze** medalist for university in Carrom and Soccer at national sports fests BOSM, SPREE | (2014) **Runner-up in National selection** for Carrom from Andhra Pradesh

TEACHING AND MENTORSHIP

- **Teaching assistant:** (2020) **MSE5860** - *Atomic structure*, Prof. Richard Robinson | (2019) **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+)
- **Sponsorship volunteer, AIESEC:** Conducted 6+ events such as mock MUNs, public speaking, & student debates