VINSE

VANDERBILT INSTITUTE OF NANOSCALE SCIENCE AND ENGINEERING

FALL 2021 NEWSLETTER

A Note from the Director

As we begin the fall semester with a campus full of students, faculty, and staff, VINSE is excited to be hosting several upcoming in-person events, including the Fall Faculty Celebration, monthly colloquia, and NanoDay (see full events list below). I encourage you to join with the VINSE community at these events and take the opportunity to reconnect with each other after more than a year of predominantly remote events. As another way to promote collaborations and awareness of research initiatives being pursued by VINSE members, newly added to this newsletter are VINSE student and faculty research spotlights (see below). Please let us know if you have exciting new research you want to share with the VINSE community for a future research spotlight. This summer, two new technical staff members joined the VINSE team with primary responsibilities in the cleanroom. Please read below about our new team members, Mike Valenti and Christina McGahan, and the extensive experience they bring to VINSE. I also want to acknowledge the new VINSE graduate student superusers, highlighted below, who have taken on important responsibilities in supporting VINSE operations based on their expertise on VINSE tools. Finally, please remember that the undergraduate VINSE tech crew is also available to support users in the VINSE facilities. Please reach out to vinse-cleanroom@vanderbilt.edu if you have process development or characterization projects that could benefit from tech crew assistance.

I hope everyone has a great semester.

Sharon Weiss
Director, VINSE

Fall Events

- September 15 - VINSE Fall Faculty Celebration
- September 22 - VINSE Colloquium, Bruce Cohen, Lawrence Berkeley National Lab
- September 30 - VINSE Graduate Student Publication Award Nomination Deadline
- October 13 - VINSE Colloquium, Guru Naik, Rice University
- October 15 - VINSE NanoDay! T-shirt Competition Deadline
- October 21 - Director's Coffee Hour
- October 29 - VINSE NanoDay! Image Competition Deadline
- November 3 - VINSE NanoDay! Poster Competition Registration Deadline
- November 19 - VINSE NanoDay!

Things to Note:

- The Director's coffee hour will be held 2pm-3pm in room 226 of the ESB.
- Stay tuned - VINSE Program Manager, Sarah Ross, hit a 25 year milestone with Vanderbilt University in June. A community celebration announcement will be coming soon.

Getting to Know New Staff

Christina McGahan is a new VINSE cleanroom staff member interested in helping researchers solve challenging scientific problems, teaching, outreach, and generally sharing her enthusiasm for nanoscience with anyone who will listen. She received her BS in physics at Gettysburg College and then moved to Nashville for a PhD at Vanderbilt in the Haglund lab studying on the interactions between metal plasmonics and vanadium dioxide. She returned to Vanderbilt after a postdoc at Mount Holyoke College fabricating and characterizing 2D material, organic semiconductor, and quantum dot FET devices, teaching both in and outside the lab, and communicating her work in an NSF- and Boston Museum of Science-sponsored Science Slam. Outside of the cleanroom her interests include swing dancing, reacquainting herself with Nashville's parks, or cooking up something tasty in her growing collection of cast iron.

Mike Valenti is the new VINSE cleanroom manager. After earning a BS in Electrical Engineering from Pennsylvania State University, Mike has gained 30 plus years of various process engineering and project management experience. Previously working in pharmaceuticals, he developed new prescription drugs and engineered novel packaging components. Before pharma Mike was a Senior Engineer, in surgical devices at Bausch and Lomb where he collaborated with the University of Southern California

and Caltech in research and development of innovative ophthalmic devices utilizing micro-electro-mechanical systems (MEMS). Designed for glaucoma patients, these devices included an implantable pressure sensor, a drainage shunt, and a low-cost disposable pressure sensor for the measurement of intra-ocular pressure during surgery. Mike also served as lab manager for the Princeton University Photonics and Opto-electronic Materials lab for nine years.

Superusers are students who have been identified as the most expert users of our core set of tools. Under VINSE's new tool training program these superusers have been volunteering their time to assist in training of new users on our most heavily used tools. These students highlight the fact that VINSE isn't just a facility, but a collaborative community that is enabled by our fantastic students. The current superuser team includes Chuchuan Hong, Alberto Esteban Linares, Elena Kovalik, Hanyu Zheng, and Fabian Ugwu.

Click here to learn more about the Superusers

We're Hiring: Staff Engineer II

VINSE is seeking to hire another technical staff member with primary responsibilities in the cleanroom.This Staff Engineer will play a critical role in VINSE's efforts to support research across a broad range of technical disciplines and interests, and to engage in education and outreach activities.Please share this opportunity with your colleagues and networks using this LINK.

Fall Faculty Celebration

The annual VINSE Fall Faculty Celebration will be held on Wednesday, September 15th at 4pm in the ESB Lobby. Join us in welcoming new members of our community, recognizing the 2020 and 2021 achievements of our faculty, and celebrating promotions. Awardees will also be announced for High Impact Paper Award and the Distinguished Service Award.

Promotions

Shihong Lin, promoted to Associate Professor with tenure, 2021

John T. Wilson, promoted to Associate Professor with tenure, 2021
Florence Sanchez, promoted to Professor, 2020
Leon M. Bellan, promoted to Associate Professor with tenure, 2020
Janet E. Macdonald, promoted to Associate Professor with tenure, 2020

Endowed Chairs
Craig L. Duvall, named Cornelius Vanderbilt Chair, 2020
Joshua D. Caldwell, named Flowers Family Chancellor Faculty Fellow in Engineering, 2020

NanoDay!

VINSE will host the 21st Annual Nanoscience and Nanotechnology Forum on Friday, November 19th. NanoDay! brings together the VINSE community of scientists and engineers working in nanoscience and nanotechnology for a day filled with research discussions and presentations.

Keynote Speaker: Teri W. Odom

Teri W. Odom is Charles E. and Emma H. Morrison Professor of Chemistry and Chair of the Chemistry Department at Northwestern University. She is an expert in designing structured nanoscale materials that exhibit extraordinary size and shape-dependent optical and physical properties. Odom pioneered a suite of multi-scale nanofabrication tools that resulted in plasmon-based nanoscale lasers that exhibit tunable color, flat optics that can manipulate light at the nanoscale, and hierarchical substrates that show controlled wetting and super-hydrophobicity. She also invented a class of biological nanoconstructs that are facilitating unique insight into nanoparticle-cell interactions and that show superior imaging and therapeutic properties.

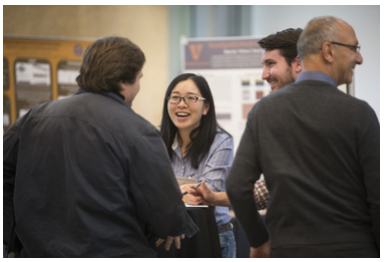
Odom is a Member of the American Academy of Arts and Sciences (AAAS) and a Fellow of the Materials Research Society (MRS), the Royal Society of Chemistry (RSC), the American Chemical Society (ACS), the American Physical Society (APS), and the Optical Society of America (OSA). She has won numerous awards and honors, and currently serves as Editor-in-Chief of Nano Letters. Odom's Personal Story of Discovery was featured by ACS Publications.

Odom will deliver the keynote address, "The Giving Nanomaterials" to the VINSE community.

VINSE Faculty Talks:

Dr. Shihong Lin, "Solute-Solute Separation: The New Frontier in Water Separation"
Dr. Janet Macdonald, “Inorganic Nanoscale Natural Product Synthesis”
Dr. John T. Wilson, "Smart Nanotechnologies for Immuno-Oncology"





Poster Session

Presenters will be evaluated by a panel of judges for an opportunity to win a cash prize.

$500 1st place (1 award)
$250 2nd place (2 awards)
$100 3rd place (3 awards)

Deadline to submit notification of intent - November 3rd

Guidelines: Each participant will be given a 48" wide and 36" tall space on which to mount their poster and must remain with their poster during the session on NanoDay!. **Judging:** Judging is based on scientific content, visual and oral presentation.

Register Here for NanoDay! & Poster Session

T-shirt Competition

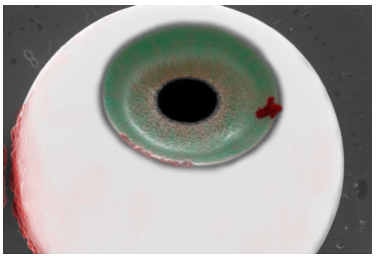
Create an attractive t-shirt design representing NanoDay! & VINSE for a chance to win $300.

The design must be exclusively your own and cannot include: logos and trademark images

- You can use any t-shirt color in your design
- JPEG format (at least 300 dpi)

- No limits to number of colors in design
- No limits to number of submissions
- Submissions must include name and email address

Send submissions to vinse@vanderbilt.edu. Deadline for submission is October 15th.



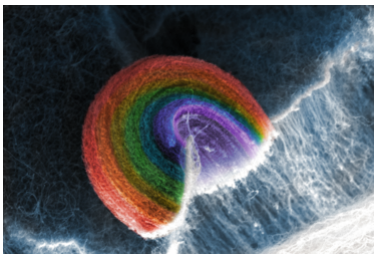


Image Competition

If you have visually attractive images of materials or devices that have been fabricated, characterized, or imaged using VINSE equipment please submit them for a chance to win a $50 prize! Photos of tools and facilities are also eligible. All winning images will be displayed proudly in the VINSE facilities.

- Image enhancement and false coloring is permitted as well as multiple submissions and collages of multiple images.
- Winning images will be printed on 8 x 10 paper, so ensure that the resolution is high enough to be clear at this size. Higher resolutions may be requested for final printing.
- With each entry indicate what the image depicts and specify which VINSE tools were used to take the image and/or fabricate the materials (e.g. Merlin, Osiris, Cleanroom, etc…).If the image has been published please provide a citation.

Send submissions to vinse@vanderbilt.edu. Deadline for submission is October 29th.

Graduate Student Publication Award

VINSE is seeking faculty nominations for the first annual VINSE Best Graduate Student Research Publication Award. This award will come with a plaque, $1,000 cash prize, and an opportunity to present at NanoDay!. Nomination deadline is September 30th.

Nomination Guidelines

Research Highlights

Jenna Mosier, 4th year graduate student in the Reinhart-King Lab

In cancer, the primary tumor microenvironment is composed of a dense network of collagen, laminins, and other extracellular matrix components that cancer cells must first navigate to escape into the bloodstream and spread throughout the body in a process known as metastasis. Cell migration through this environment is a complex, process dependent on both the architecture and biochemical properties of the surrounding environment, as well as the genetic and epigenetic heterogeneity of cells. Interestingly, mechanical cues imparted on cells by the matrix, such as highly confining pores and tunnels, have significant effects on cell speed and bioenergetics. To parse these environmental effects on cell behavior, our lab has developed a technique to create highly relevant, collagen microtracks that can mimic the native architecture of the tumor microenvironment. To do so, we utilize the equipment in the VINSE to first pattern a silicon wafer master with our desired microtrack geometries. We then cast this master in polydimethylsiloxane (PDMS) to create a reverse template of the wafer. The resulting PDMS stamp is then used to mold liquid collagen, forming microtracks to study cell behavior in vitro. Using this technique, I study highly metastatic breast cancer epithelial cells in varying degrees and patterns of confinement to determine how the confinement affects their speed and behavior. Not only have we seen increased migration speed when cells are fully confined (Mosier*, Rahman-Zaman* et al, Biophysical Journal, 2019), but we are currently working to determine if confinement results in mechanical memory that informs future motility and migration behavior, and how cells alter their metabolism to meet the different energetic requirements of high degrees of confinement. Understanding the mechanism driving these cellular responses to confinement may aid in identifying key targets for inhibiting cancer cell migration and metastatic spread.

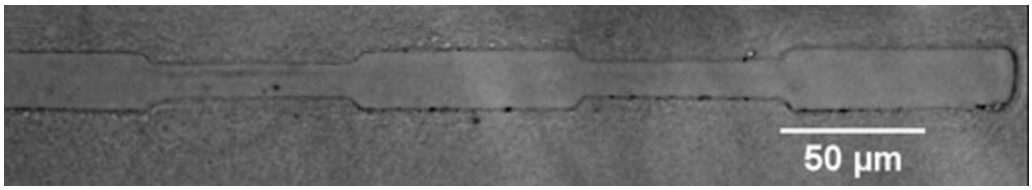


Figure 1: Image of microtrack stamped into collagen gel with alternating pattern from low to high confinement. Image taken with Zeiss confocal laser-scanning microscope

Ruben Torres, 3rd year graduate student in the Rosenthal Lab

Abnormal signaling of the neurotransmitter dopamine has profound clinical consequences, as supported by multiple dopamine-related brain disorders including Parkinson's disease, attention-deficit hyperactivity disorder, bipolar disorder, schizophrenia, and autism spectrum disorder. The dopamine transporter (DAT) is a presynaptic transmembrane protein that facilitates the reuptake of secreted dopamine following neurotransmission and is a potential key factor in understanding the origin of these brain disorders. What is still unknown is the degree to which DAT surface trafficking identified in monolayer cell culture is physiologically relevant in vivo. The Rosenthal group aims to investigate DAT surface trafficking in live brain tissue utilizing

DAT specific antagonist conjugated quantum dots to provide insight into DAT mechanisms in related brain disorders. The group has devised a system for DAT single-particle tracking in acute brain tissue consisting of a symmetrically shelled quantum dots directly conjugated to a DAT antagonist. My project focuses on probe optimization to mitigate off-target binding. I synthesize and characterize the quantum dot constructs, as well as screen them in monolayer cell culture and mouse brain tissue slices using different optical microscopy modalities. Insight gained from this work could lead to the development of novel diffusion recovery therapeutics, potentially supplementing classical agonist/antagonist drug targeting.

Piran Kidambi, Assistant Professor of Chemical and Biomolecular Engineering & Mechanical Engineering

The Kidambi lab's research leverages the intersection between i) in-situ metrology, ii) process engineering and iii) material synthesis to enable bottom-up novel materials design and synthesis for energy, membranes, electronics, catalysis, metrology, environmental protection and healthcare applications. The key scientific questions in the field relate to understanding mechanisms for atomistic control during nanomaterial synthesis, while the engineering challenges center around developing scalable production processes and interfacing nanomaterials into functional systems to realize applications. Group members are pursuing the following current research projects: 1) Synthesis of new 1D and 2D materials via bottom-up synthesis processes with a focus on understanding growth mechanisms and using gaseous as well as liquid systems; 2) Fabrication of atomically thin membranes for ionic and molecular separations with a focus on understanding nanoscale mass transport; 3) Design of novel separation processes by leveraging nanoscale interactions for isotope separations; and 4) Exploring material synthesis and material properties using in-situ metrology such as in-situ TEM, in-situ XPS, and in-situ SEM.

Justus Ndukaife, Assistant Professor of Electrical Engineering & Mechanical Engineering

Once thought of as a means for cells to expel wastes, in recent years, extracellular vesicles (EVs) have generated enormous attention because they contain important biological molecules including proteins, DNA, mRNA, and miRNA, and represent an important means for cells to communicate with neighboring or distant cells. Extracellular vesicles are heterogeneous both in size, molecular composition, and biogenesis, hence the need for single vesicle analysis. Due to their small size, the stable trapping of nano-sized vesicles using optical tweezers (recently recognized with one-half of the 2018 Physics Nobel Prize) and sensitive detection of single EVs has been met with challenges because of the diffraction limit of light. The Ndukaife team are developing novel optical nanotweezer technologies capable of nano-optical trapping, and multiplexed detection of molecular markers on individual extracellular vesicles. These novel non-

invasive optical nanotweezers with multifunctional capabilities are expected to open new horizons by enabling to address fundamental questions in EV biology and drive translational applications in EV-based liquid biopsy for non-invasive early cancer detection.

Summer REU

This summer VINSE successfully ran a hybrid NSF REU summer program. A total of 9 undergraduates carried out nanoscale science and engineering research on campus or via remote participation.
Together with the 4 summer VINSE Tech Crew members, these undergraduates presented their 10 week research findings at an interactive virtual poster session. The VINSE community was joined by faculty from the undergraduates' home institutions as well as their family and friends. Two $1000 travel awards were granted to the top two presenters:

Thiago Arnaud: Florida International University, Mechanical Engineering - Caldwell lab
Alessia Williams: Prairie View A&M University, Chemical Engineering - Jennings lab

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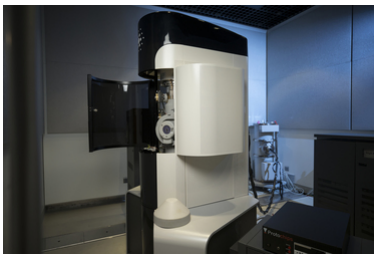

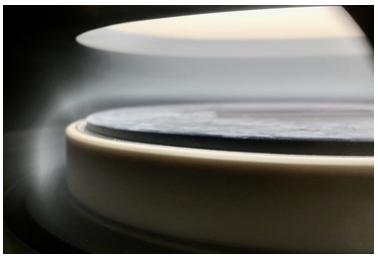

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