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NanoMeter

The newsletter of the Cornell NanoScale Facility

Spring 2022 • Volume 31 • Issue 1

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The front, back, and background images are explained on page 4. Other photographs in this issue were provided by the author, researcher, CNF staff, or as noted. The director photographs were taken by University Photography.

The NanoMeter is formatted by Melanie-Claire Mallison. She welcomes your comments and corrections at mallison@cnf.cornell.edu

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CNF Cornell NanoScale Science and Technology Facility

National Nanotechnology Coordinated Infrastructure

Cornell University

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Directors' Column for Spring 2022 NanoMeter

"If we had no winter, the spring would not be so pleasant: if we did not sometimes taste adversity, prosperity would not be so welcome." ~ Anne Bradstreet

Spring has sprung and so has the 2022 edition of the NanoMeter! A renewed energy always seems to follow the end of the dark, cold winter months. That same feeling of renewal is also starting to emerge as the challenges and constraints of the COVID-19 pandemic are lifting. The experiences the CNF community weathered continued to present a unique, ever-changing landscape for the staff, users, and operations at the CNF. However, as we move ahead with the "new normal" — the CNF is energized and ready to go!

This year we look forward to celebrating a very special occasion at the CNF — our 45th Anniversary. The Cornell NanoScale Science and Technology Facility (CNF) evolved from our first NSF-supported sub-micron facility founded in 1977; dedicated to nanoscale science and technology, it forged ahead establishing itself as a world class institution committed to the users and students it served. This landmark will be celebrated during the 2022 CNF 45th Anniversary Annual Meeting. We are pleased to announce this meeting will be held in person on Tuesday October 18th with special activities planned for Wednesday, October 19th to mark the commemorative event.

Directly after our 45th Anniversary, the CNF will be hosting the National Nanotechnology Coordinated Infrastructure's (NNCI) Annual Conference scheduled for October 19th through the 21st. This is our opportunity for NNCI directors and staff to share news and collaborations.

In celebration of our 45th anniversary we are also excited to announce a special collaboration with the Ithaca Sciencenter. A Nano Exhibit has been installed that introduces visitors to the basics of nanoscience through hands-on interaction. The CNF is proud of its ongoing outreach efforts and welcomes partnerships with organizations committed to educating the community, particularly young children, to nanotechnology, and interesting them in science, technology, engineering and math careers. See pages 20-21 for more information on our youth outreach.

CNF has completed the organization of three partnerships intended to help grow the CNF's 3D fabrication/characterization and testing capabilities. These expanded relationships are with the Cornell Institute of Biotechnology (Biotech), the Rapid Prototyping Lab, and the High Frequency Test Lab (HFTL). More information regarding equipment capabilities of these three partnerships are provided on pages 11-14.

The CNF has assumed a leadership role in helping to establish the New York State Nanotechnology Network (NNN). The overall mission of the NNN is to help build local relationships, solve common problems and grow awareness of the state's capabilities as they pertain to nanotechnology while providing more synergistic opportunities for workforce development within the state. On May 19th, the CNF will host the first NNN Symposium focused on connecting NYS undergraduate and graduate students with our NYS industry partners for the purpose of "Bridging the Workforce Gap." The goal of this in-person career fair themed symposium is to showcase the NYS student workforce talent pipeline and to bring together universities and industries to exchange information and present technology research activities in and around the state. Please take a moment to check out some of the exciting details on page 6.

REGISTER RIGHT NOW FOR THE NNN SYMPOSIUM, IN PERSON ON MAY 19TH!

https://tinyurl.com/2022NNN

On May 19-20, 2022, the Third Annual Intercampus Cancer Research Symposium will be held in person at the Cornell College of Veterinary Medicine (see page 16). The CNF is honored to support this important symposium that will focus on the

connections between cancer and immunology. Presentations followed by breakout sessions will enable participants to exchange innovative ideas and expand on intercampus research efforts. In August 2022 the CNF will host the NNCI's Research Communities Nano-IoT symposium. The goal of this meeting is to summarize, inform, and create a space for the work exchange of NNCI users in the Nanoscale Internet-of-Things (Nano-IoT) research arena.

Finally, we are pleased to offer the return of the in-person, 3.5-day, CNF Short Course: Technology & Characterization at the Nanoscale (CNF TCN), Tuesday-Friday, June 7-10. We are planning many informative changes to the schedule to make for a more dynamic learning experience. Details are provided on page 5 — be sure to register soon!

The CNF takes pride in its facilities and ensuring a positive research experience for users. Preventative maintenance initiatives play an integral role in the provision of a functioning, state-of-the-art facility. Please note the cleanroom will be shutdown for HEPA filter replacement and other important upkeep starting in December 2022 and will be closed for about eight weeks.

Here's to new beginnings and new initiatives as we continue to shape the future of nanotechnology and the CNF. We appreciate the ongoing support of our users, and we look forward to welcoming everyone back to campus!

Christopher Ober
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CNF Creates Cornell University Crest Background

For President Martha Pollack's use as a zoom background, we created the Cornell University crest in a 300 nm thin film of silicon oxide by etching down to about 150 nm after a brief exposure to a CHF_3/Ar plasma. The crest was etched using a "clear field" photomask, which emphasized the features as the oxide got etched around the pattern. The sample was then coated in ~10 nm of gold to prevent electron charging effects when imaged by the SEM.

- Tools used: Oxford PECVD, MA6 Contact Aligner, Oxford 81, YES EcoClean, Polaron Gold Sputterer, Zeiss Ultra SEM, Dektak XT Profilometer
- Staff involved: Jeremy Clark, George (Mac) McMurdy, technical staff; Melanie-Claire Mallison, photoshop and PowerPoint graphics.
- See this issue's cover and background!

Office of the President, January 31, 2022:

Dear Melanie-Claire,

A quick note to share that the Cornell crest background was a huge hit at a recent Board of Trustees meeting. Many of us were using it as of Thursday. There were even more people using it Friday.

Thank you again for writing to me with this idea and for working with the CNF team to make it happen.

Best,

Martha E. Pollack
President, Cornell University
300 Day Hall
Ithaca, NY 14853
www.cornell.edu

2022 JUNE CNF TCN!

CNF will be hosting our biannual Technology and Characterization at the Nanoscale (TCN) short course in person Wednesday through Friday, June 8-10, 2022 (with an orientation on Tuesday evening).

Updates to this year's programming include guest lectures by Cornell University investigators in the areas of Microfluidics, Micro-Electro Mechanical Systems (MEMS), and Novel Applications of 2D Materials.

Moving forward, CNF plans to host the TCN short course in person every June and virtually each January in order to reach and educate the broadest possible audience.

REGISTER NOW!
https://cnf.cornell.edu/education/tcn

New York State Nanofabrication Network and Workshops/Symposiums

Serving as a part of the National Nanotechnology Coordinated Infrastructure (NNCI), the CNF is a regional resource for nanotechnology and economic development. The CNF is recognized as a world-class, open access micro- and nanofabrication facility located in New York State. Since its inception in 1977 the CNF has significantly impacted and expanded scientific progress spread across multiple disciplines including, the physical sciences, engineering, and life sciences. New York State is home to several, independently operated government, industrial and educational organizations with various capabilities involving micro- and nanotechnology, semiconductor processing/research centers and packaging facilities. However we all operate independently.

In 2020 the CNF initiated, organized and hosted a first of its kind, introductory workshop focused on bringing NYS universities and industries together to discuss and learn more about possible synergies. The initial meeting covered topics including resource sharing and collaborative work opportunities aimed at promoting state economic growth, job creation, workforce training and funding acquisition.

This inaugural NYS Academic Cleanroom Workshop helped to establish partnerships that will serve and strengthen New York as future opportunities present themselves.

Fifty individuals representing eight universities, six companies, and three government organizations participated in the event. Breakout discussions helped to further identify and clarify possible synergies while determining next steps/activities to assist the alliance in driving NYS impact as a key stakeholder in the nanotechnology industry.

REGISTER RIGHT NOW FOR THE NNN SYMPOSIUM, IN PERSON ON MAY 19TH!

https://tinyurl.com/2022NNN

Results from the initial workshop led to follow up activities that included smaller focus groups. CNF took the lead by continuing to organize follow up activities that included the following target areas:

The Startup/Early-Stage Company Focused Workshop

Date: February 23, 2021

Hosts: Bruce Toyama (NYCreates/University of Albany) and Ron Olson (Cornell).

- This workshop allowed local startup companies (Odyssey Semiconductor, Pallidus, Ambature, Lux Semiconductors, and Vyir) to share their experiences and what was learned during the process of creating and building a start-up. It also allowed the companies to expand on areas of need (current and future) in relation to cleanroom capabilities/access. The resources required for commercialization success were also discussed with participants.

The Nanotechnology Workforce Development Workshop

Date: March 15, 2021

Hosts: Denis Cormier (RIT), Chris Ober (Cornell), and Mark Poliks (Binghamton)

- This session highlighted issues and capabilities related to workforce development. In-depth discussion regarding opportunities for cooperation within the state were a key component of the workshop.

The Nanotechnology Roadmap Workshop

Date: April 1, 2021

Hosts: Ron Olson (Cornell) and Vinny Guerriero (Applied Materials).

- This workshop focused on desired outcomes from a statewide network or alliance of nanotechnology facilities as well as key strategies that would assist with the establishment of an alliance in NYS.

These initial workshops successfully enabled an exchange of ideas between leaders from multiple

sectors within New York. A total of 95 stakeholders from 12 different NYS academic institutions, 20 NYS companies, the NY State Senate, NY State Economic Development, NNCO (the National Nanotechnology Coordinating Office) and Senator Chuck Schumer's office were represented at the initial and follow-up workshops. The sessions effectively established a foundation for the newly named, New York Nanotechnology Network (NNN). The overall mission of the NNN is to help build local relationships, solve common problems and grow awareness of the state's capabilities as they pertain to nanotechnology. Participation in this network provided a much-needed mechanism to showcase the capabilities within the state; allowing universities/colleges and industry to partner and expand technology. A steering committee for the NNN, comprised of representatives from NY State academia and industry has been established. Committee members include Nava Ariel-Sternberg from Columbia University, Vinny Guerriero from Applied Materials, Karl Hirschman from RIT, Mark Poliks from SUNY Binghamton, Bruce Toyama from SUNY Albany, and Ron Olson and Chris Ober from Cornell.

The next NNN gathering is scheduled for May 19, 2022. The meeting will focus on connecting NYS undergraduate and graduate students with industry partners for the purpose of "Bridging the Workforce Gap". The goal of this career-fair-themed symposium is to showcase the NYS student talent pipeline and to unite New York State colleges, universities and industries for the purpose of exchanging information and sharing technology research activities. The day's agenda includes introduction of the NNN, student/government and industry talks and a poster session as well as a Career Fair for job networking.

The CNF, New York State, and surrounding regional areas have already begun to realize the benefits of the introductory workshops and establishment of the NNN. CNF along with other regional and national academic and industrial organizations are already establishing alliances to address the ongoing, global semiconductor shortage responsible for the disruption of supply chains impacting consumers and businesses, and threatening national security. It is firmly maintained that these workshops have already benefited NYS industrial, academic, and government entities.

The NNN provides expanded capabilities and the possibility for synergies that will serve to further strengthen technology and the workforce in New York. Together we can significantly impact the growth and development of technology within the state of New York with the added potential to establish the NNN as a partnership model committed to the advancement of nanotechnology across disciplines in the United States.

CNF 45th Anniversary!

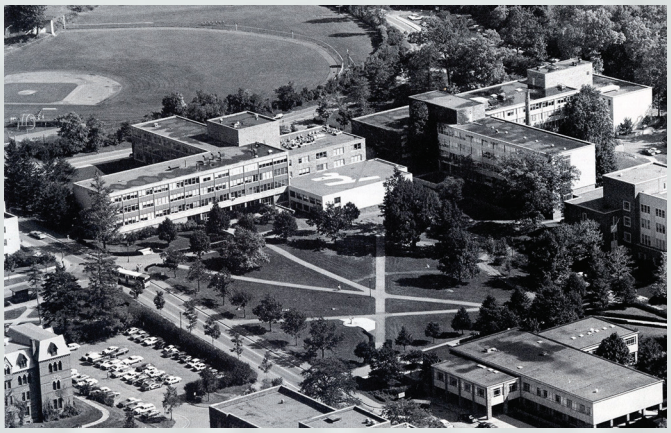
The Cornell NanoScale Science & Technology Facility (CNF) began in 1977.

In 1976, the National Science Foundation held workshops across the country to assess the need for a university-based national research and resource facility for submicron structures (NRRFSS), and then solicited proposals.

The winning proposal, from Cornell University, was coordinated by Prof. Joseph M. Ballantyne, School of Electrical and Computer Engineering.

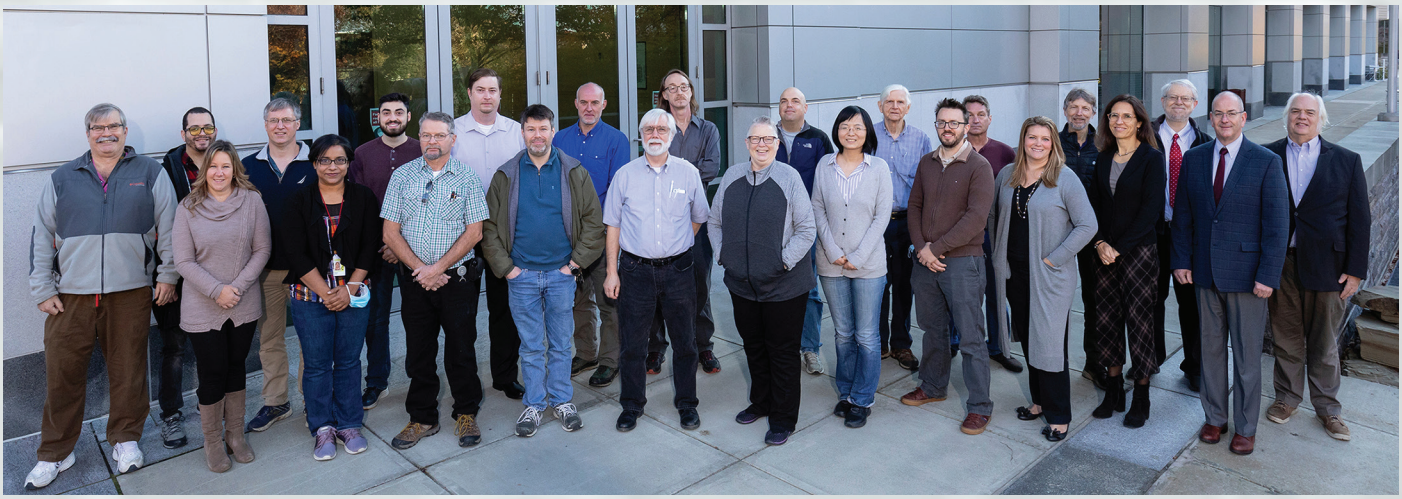
NRRFSS opened in 1977 and Cornell appointed Prof. Ballantyne as Acting Director. He was then our very first principal investigator with project, #1-78, "Materials and Technology for Integrated Optical Devices." Prof. Ballantyne was quickly followed by principal investigators Prof. Robert Buhrman, Applied & Engineering Physics (#2-78, "X-Ray Lithography") and Prof. Lester Eastman, Electrical & Computer Engineering (#3-78, "Josephson Device Research").

Approximately 4,000 projects and 15,000 users later, the CNF celebrates its 45th anniversary!



NRRFSS building (circa 1984) and staff (circa 1986). UPhoto.

Duffield Hall and examples of CNF-research-related devices, circa 2019.



The Cornell NanoScale Science and Technology Facility staff as of Winter 2021. Simon Wheeler Photography.

2022 CNF 45th Anniversary Annual Meeting

Tuesday-Wednesday, October 18-19, 2022

The 2022 CNF Annual Meeting will be a Celebration of our 45th Anniversary!

The CNF annual meeting is a special event and an excellent opportunity for our colleagues to learn of the exciting research carried out CNF over the past year. Since 2022 is our 45th anniversary, so we'll have extra special activities! We'll likely have invited speakers, many many CNF user posters, a panel discussion on the future of nanotechnology, and of course, our evening Poster Session & Corporate Soiree.

Plans are in the beginning stages, so check back often to find out more!
https://cnf.cornell.edu/events/annual_meeting/2022

If your company would like to sponsor the CNF 45th Anniversary Celebration, please contact our director of operations, Ron Olson, olson@cnf.cornell.edu

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CNF CLEANROOM CLOSURES — MAY & DECEMBER!

2022 Campus Steam Shutdown 5/31-6/3

CNF Researchers,

The CNF will be closing the cleanroom during the Annual Cornell Campus Wide Steam Shutdown May 31st to June 3rd this year. The lab will close at 6:00 a.m. on Tuesday 5/31 and will re-open at 12:00 noon on Friday 6/3.

Second floor lab spaces, the CAD room and the P154 Packaging Lab will remain open, however the building will not have temperature control, humidity control or hot water during this time.

Also, Monday May 30th is Memorial Day and a staff holiday, CNF staff will not be available for tool support — use the buddy system for chemical hood usage on this day.

While the cleanroom is closed, staff will be working on tool maintenance and general lab cleaning. If you have samples that are left out on tables or tools they will be removed. Please make sure your samples are properly stored, if you need a storage bin please email me directly. The CNF has limited sample storage space, the intent is for "in process samples and masks" only. Old samples, masks, supplies, etc., should be removed from the cleanroom and stored in your own space.

Phil Infante
pi12@cornell.edu

CNF Cleanroom Shutdown in December

Dear CNF Community,

The cleanroom shutdown for HEPA filter replacement and other important work is now planned for about eight weeks, December 19, 2022 - January 2023.

The work will now include replacing the corroded acid exhaust duct, which was not part of the original project. However, if further examination indicates that this specific repair cannot wait, we will need to briefly shut down the cleanroom sooner to do that work.

We will continue to communicate the status of the shutdown when we have more information.

Ron, Lynn, and Phil
olson@cnf.cornell.edu

CORNELL NANOSCALE FACILITY PARTNERSHIPS

Cornell Visualization and Imaging Partnership (CVIP)

CNF and the Cornell Institute of Biotechnology (Biotech) partnered to further advance Cornell's excellence in life science characterization and imaging capabilities. Under this arrangement, CNF provides partial support for one senior staff member in Biotech, and is integrating activities of this partnership into our user support and new project support process. CNF cleanroom and Biotech users are now able to mutually access resources in both centers. The expertise of the Biotech staff in imaging a wide range of materials will add considerably to our capabilities. Likewise, Biotech users will have easy access to CNF's fabrication facilities and staff expertise. The mission of this partnership is to foster and enhance the convergence of research fields while unifying new approaches and ideas to inspire innovation and discovery.

CNF users now have access to a broad range of 3D characterization tools including:

Zeiss Xradia 520 Versa Nano-CT (Figure 1):

- **The Zeiss Versa 520 is used to examine the 3D structure of materials non-destructively. It can scan at a wide variety of resolutions (from 150 nm to 50 μm/pixel)**

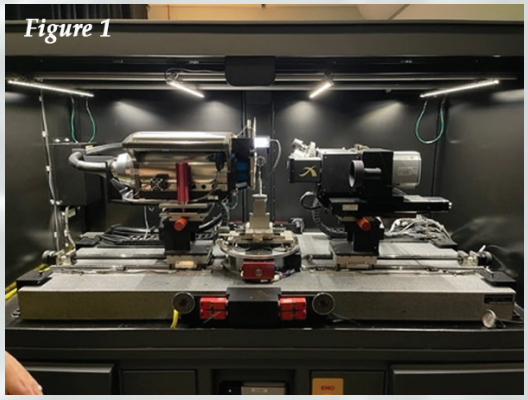


Figure 1

Bruker Skyscan 1276 Micro-CT:

- **The Bruker Skyscan 1276 micro-CT is ideal for scan of small live animals or soft materials. The system is equipped with onboard anesthesia, dosage monitoring, gating, and can scan a resolution of between 5 μm to 80 μm/pixel.**

Super Resolution Microscope (Zeiss Elyra PS.1):

- **The Elyra super resolution microscope is used to examine cells and materials at resolutions beyond the typical diffraction limits of optical microscopy. The Elyra supports SR-SIM, TIRF, PALM and STORM microscopy.**

Light Sheet Microscope (LaVision BioTec) (Figure 2):

- **This light sheet microscope is ideal for examining cleared biological specimens up to a centimeter in diameter, and can realize them with micron-scale resolution. The facility also has computing software for visualization and analysis of the resulting datasets.**

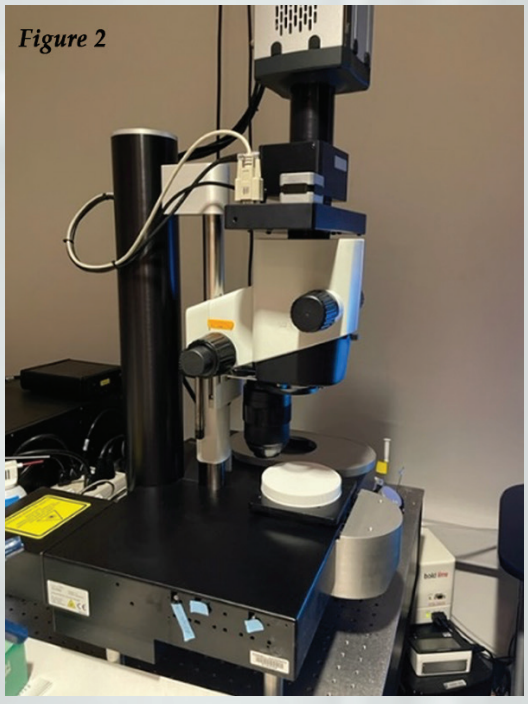


Figure 2

Confocal Multiphoton Microscope (Zeiss LSM880 "u880"):

- **The Zeiss LSM u880 is an upright confocal microscope suitable for three-dimensional visualization of fluorescently labeled cells, thin tissue sections, or thin materials.**

Confocal Multiphoton Microscope (Zeiss LSM880 "i880"):

- **The Zeiss LSM i880 is an inverted confocal microscope suitable for three-dimensional visualization of fluorescently labeled cells, thin tissue sections, thin materials, and a heated/CO_2 controlled chamber for imaging live cells in dishes.**

Confocal Microscope (Zeiss LSM710):

- **The Zeiss LSM 710 is an inverted confocal microscope suitable for 3D visualization of fluorescently labeled cells, thin tissue sections, thin materials, and a heated/ carbon dioxide (CO_2) controlled chamber for imaging live cells in dishes.**

Spinning Disk Confocal Microscope (Andor):

- **The spinning disk confocal microscope has multiple cameras, enabling fast confocal imaging of multiple fluorophores simultaneously.**

Fluorescence Upright Metamorph (Olympus):

- **Optical microscope for inspecting fluorescent cells or materials.**


Figure 3

Stereomicroscope (Zeiss):

- Low resolution inspection microscope for quick inspection and manipulation of samples in the millimeter to centimeter size scale.

IVIS Spectrum (PerkinElmer):

- The IVIS takes macro fluorescence or bioluminescent images of small live animals, plants, or materials up to ~ 10 cm in size. Includes anesthesia and temperature control for live animal imaging and both 2D and 3D imaging modes.

Microbeam Laser Capture Microdissection System (Zeiss):

- The laser capture system performs non-contact dissection and capture of cells, thin tissue sections, and polymeric materials under 20 μm thick. Laser cutting can be done at sub-micron resolution.

PTI Fluorometer QuantaMaster 400 (Horiba):

- The QuantaMaster measures fluorescent excitation or emission of liquids or transparent materials of up to 1 cm^2 in cross section.

Absorption Spectrometer Cary 300 UV-Vis (Agilent):

- The Cary-300 spectrophotometer can measure light absorbance of liquids or materials of up to 1 cm^2 in cross section, in a wavelength range of 190-800 nm.

Vevo-2100 (VisualSonics) (Figure 3):

- The Vevo-2100 is an ultrasound imaging system designed for high resolution imaging of small animals, plant morphology, or other systems with fluid flow, and includes anesthesia, EKG, and breath monitoring.

Seahorse XFe96 (Agilent):

- The Seahorse systems measure live cell metabolism. The XFe96 measures cells in 96-well plates.

Seahorse XFp (Agilent):

- The Seahorse systems measure live cell metabolism. The XFp measures cells in 8-well mini-plates.

Hypoxia Incubator:

- The HeraCell 150i is a cell incubator that can maintain cultured cells in hypoxic conditions.

Cornell Multiscale 3D Fabrication Partnership (CM3FP)

CNF has also partnered with the Rapid Prototyping Lab in the Mechanical Engineering department to provide access to additional multiscale, 3D printing resources making a broader range of technologies available to our users. This resource will leverage existing expertise, instrumentation/tools, and administrative support to increase the impact of these resources on research that involves life sciences, heterointegration and nano/micro-scale technology. CNF and RPL staff will act as a gateway to these new 3D printers, providing consultation, software services, design help, billing, and user support.

CNF users now have access to a broad range of 3D printing tools that include:

Stratasys F370 (Figure 4):

- Fused deposition modeling (FDM) machine with dual extrusion. One head extrudes ABS, PLA, and ASA build material and the other a dissolvable support material. Ideal for models that need to mimic the strength and detail of plastic injection molding.

Figure 4

Fortus 250mc:

- Fused deposition modeling (FDM) machine with dual extrusion. One head extrudes ABS Plus build material and the other a dissolvable support material. Ideal for models that need to mimic the strength and detail of plastic injection molding and parts that are accurate, stable, and durable.

uPrint SE:

- Fused deposition modeling (FDM) machine with dual extrusion. One head extrudes ABS, PLA, and ASA build material and the other a dissolvable support material. Ideal for models that need to mimic the strength and detail of plastic injection molding.

Formlabs Form 3:

- Low force stereolithography (LFS) machine that uses a laser to zap liquid resin into solid form. It uses build materials such as resin (clear, tough, etc.). It includes post-processing with Form Wash to remove the uncured resin from the surface of printed parts by soaking it in either isopropyl alcohol (IPA) or tripropylene glycol monomethyl ether (TPM) and second step Form Cure Post-Curing using 405 nm wavelength UV light to achieve their highest possible strength and stability. Ideal for high resolution and strength models.

Ultimaker 3 (Figure 5):

- Fused deposition modeling (FDM) machine with dual extrusion and an open filament system. One head extrudes PLA Plus build material and the other a dissolvable support material. Ideal for models that do not require high resolution, but have empty spaces that need removable support.

Ultimaker 2+:

- Fused deposition modeling (FDM) machine with a singular head that extrudes PLA build material and has an open filament system. Ideal for parts with no empty spaces or do not need removable support material.

Monoprice MakerSelect:

- Fused deposition modeling (FDM) machine with a singular head that extrudes PLA and TPU build materials and has an open filament system. Ideal for parts with no empty spaces or that do not need removable support material.

Lulzbot Taz6:

- Fused deposition modeling (FDM) machine with a singular head that extrudes PLA build material and has an open filament system. Ideal for parts with no empty spaces or do not need removable support material.

Markforged Mark Two (Figure 6):

- Fused deposition modeling (FDM) machine with dual extrusion. One head extrudes onyx build material and the other micro carbon fiber infill. Ideal for stiff, strong and durable models.

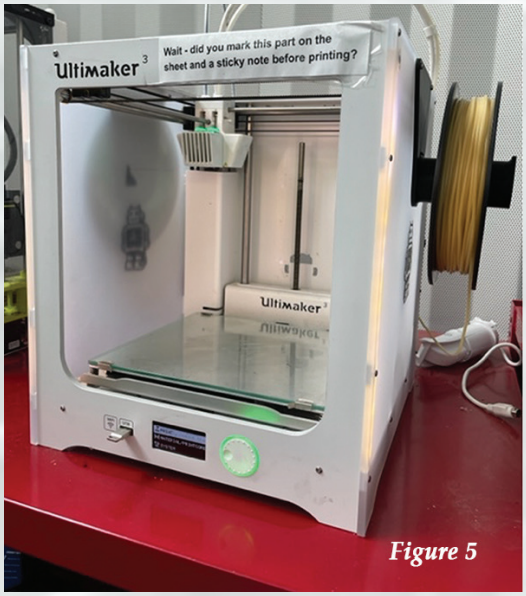


Figure 5

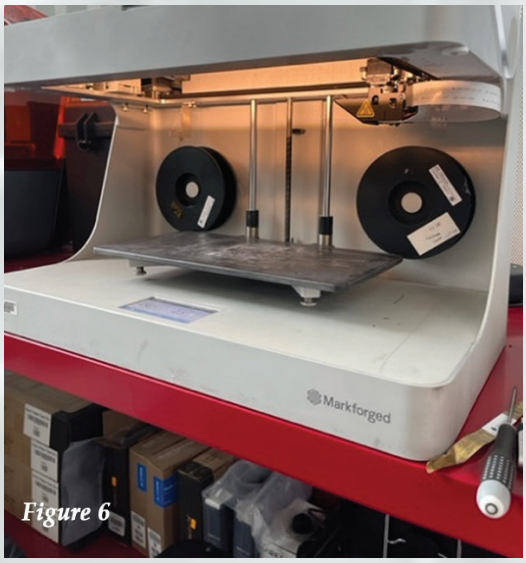


Figure 6

Objet 30 Scholar:

- The Objet30 Scholar uses a polyjet 3D printing technology to print a proprietary UV-curable polymer that mimics polypropylene. It uses build materials such as Vero: white, black, blue, or gray. A support polymer is printed in the empty spaces that can be removed by water washing.

Epilog Legend 36EXT:

- 60-Watt laser with optimized raster, vector or combined modes with engraving and cutting in one job. Ideal for ¼" thick material such as wood and acrylic.

Epilog Mini 24:

- 60-Watt laser with optimized raster, vector or combined modes with engraving and cutting in one job. Ideal for ¼" thick material such as wood and acrylic.

High Frequency Test Lab

The Materials Science and Engineering (MSE) department agreed to make the instruments in the High Frequency Test Lab (HFTL) available for shared use as part of CNF facilities. These advanced instruments are now available to the broader Cornell and non-Cornell community. This fulfills a commitment made as part of the NSF MRI award for the new millimeter-wave probe station and electronics to be available for shared use.

The instruments in HFTL are now part of the CNF and include:

DC Probe Station and Electronics (Figure 7):

- **A Cascade Summit 12K probe station with 8-inch chuck is available for DC wafer probing. The system includes four high-precision Cascade 208 and 210 DC probe positioners with Kelvin probes, microscope, digital camera, and is coupled with a Temptronic TPO3000 ThermoChuck system with -50 to 200°C chuck temperature control capability. An Agilent 4156C precision semiconductor parameter analyzer with four high-resolution source measurement units (HRSMU) with ± 100V max, one high-power source measurement units (HPSMU) with ± 200V max, and an Agilent 4294A precision impedance analyzer are available and are controlled by a PC with Keysight ICCAP software.**

Microwave Small Probe Station and Electronics (Figure 8):

- **A Cascade Summit 9600 probe station with 6-inch chuck is available for RF wafer probing. The system includes two Cascade RF probe positioners, microscope, digital camera, and is coupled with a Temptronic TPO3000 ThermoChuck system with -50 to 200°C chuck temperature control capability. An Agilent E8364B PNA network analyzer is capable of RF measurement in 10 MHz to 50 GHz frequency range with 104 dB of dynamic range, 26 usec / point measurement speed, 32 channels, and 16,001 points, is available. In addition, an Agilent 4156C precision semiconductor parameter analyzer with four high-resolution source measurement units (HRSMU) with ± 100V max and one high-power source measurement units (HPSMU) with ± 200V max are available for DC biasing.**

Millimeter-Wave Vector Network Analyzer and Probe Station:

- **A MPI TS2000-IFE Series automated probe station with 1 μm precision is available for RF wafer probing. The system includes two RF probe positioners, microscope, and digital camera along with a MPI thermal chuck with temperature control between -60°C and +200°C. An Anritsu ME7838G vector network analyzer (VNA) capable of single-sweep measurement from 10 MHz to 220 GHz with dynamic range of 120 dB at 10 MHz, 112 dB at 67 GHz, 108 dB at 110 GHz, and 100 dB at 145 GHz, and measurement speed of 310 ms for 401 points at 10 kHz IFBW, is available.**

Microwave Large Signal Test System (Figure 9):

- **Load-pull system. A Cascade Summit 11K probe station with 8-inch chuck is available for RF wafer probing. The system includes two Cascade RF probe positioners, two tuners for fundamental frequency, microscope, and digital camera. The load-pull system is capable of large signal RF measurement up to 20 GHz and -20 dBm maximum output power. Maury ATS software with a dedicated PC is available for controlling.**

Figure 7

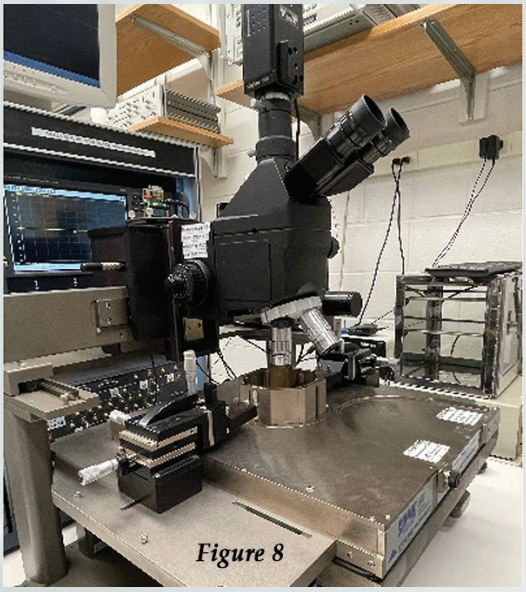


Figure 8

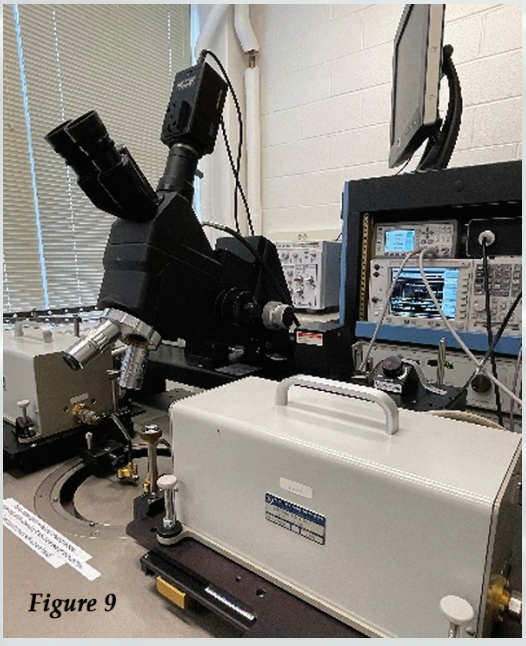


Figure 9

2022 NNCI Etch Symposium at the University of Pennsylvania

The 2022 NNCI Etch Symposium, Advances in Micro- and Nanoscale Etching for Novel Electronic, Photonic, and Quantum Based Devices, was held on April 21-22 at the University of Pennsylvania. The event was hosted by the Singh Center for Nanotechnology. Due to overwhelming interest, the symposium offered a hybrid format so that those who couldn't attend in person could do so virtually.

The National Nanotechnology Coordinated Infrastructure (NNCI) is an NSF sponsored network of 16 sites involving nearly 30 university shared research facilities across the United States (https://www.nnci.net). The NNCI encourages these network wide events to bring together technical experts within a specific fabrication area. A principal objective of this symposium was to bring together etch professionals in an interactive forum where collective knowledge on etch processes and their application to state-of-the-art devices can be shared.

The symposium had in excess of 60 on-site attendees from academic and corporate sites. The academic attendees came from sites within and outside of NNCI. The participating NNCI sites included Cornell, Harvard, Stanford, Minnesota, Georgia Tech, University of North Carolina, UC-San Diego, Penn, Nebraska, U-Chicago, and Washington. Non-NNCI institutions included Princeton, MIT, UC-Santa Barbara, Yale, Purdue, Michigan, Penn State, and Northeastern.

Day 1 featured talks by NNCI sites on the status of their etch equipment, including any new acquisitions and newly developed processes. In addition, Day 1 featured technical presentations and exhibits by etch equipment vendors including Oxford Instruments, Plasmatherm, and SPTS, highlighting etch capabilities for electronic, photonic, and quantum based devices. These specifically included:

- **Russ Renzas-Oxford Instruments: Atomic Layer Etching for Low Loss Quantum Devices**
- **David Lishan-Plasmatherm: Low Temperature Plasma Technology for Advanced Packaging Applications**
- **Josh Perlstein-SPTS: Endpoint Detection for Plasma Etching**

Day 2 featured invited and contributed talks by scientists from academic and corporate labs including:

- **Tony Zhou-MIT: Quantum Applications Build on Creative Nanofabrication**
- **Troy Olsson-Penn: Etching of AlScN Materials**
- **Ben Davaji-Northeastern: Role of Artificial Intelligence in Nanofabrication**
- **Rebecca Cheng-Harvard: Lithium Niobate Nanophotonic Platform for Non-linear and Quantum Optics**
- **Daniil Luken-Stanford: Quantum and Non-linear Photonics in SiC**
- **Christian Reimer-Hyperlight Corp.: Faster and Lower Power Solutions via Thin Film $LiNbO_3$.**

Day 1 participants at the Singh Center for Nanotechnology.

Etch Symposium Day 2, continued

- Sid Ghosh-Northeastern University: Photonic Waveguides and Acousto-optic Devices on AlN
- Lidan Zhang-Penn State: Fabrication of Silicon, Silicon Nitride, and InGaP Optical Metasurfaces with Dry Etching
- Demis John-UC Santa Barbara: Ruthenium Hard-masked Silicon Dioxide Etching
- Matteo Rinaldi-Northeastern: Applications of AlN and AlScN Devices

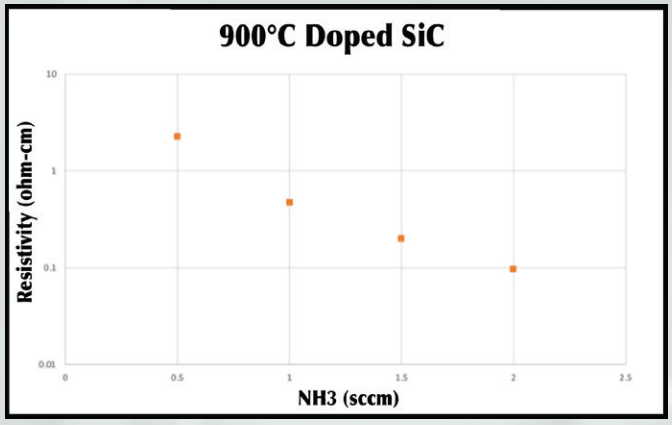
Special thanks to the vendors for their sponsorships at the gold, silver, and bronze levels, making the event possible including: Oxford Instruments, Plasma-Therm, SPTS(KLA), Samco, TedPella, and RFVII.

The symposium was organized by Vince Genova-Cornell, Ling Xie-Harvard, Eric Johnston-Penn, and Jason Tower-Stanford. We look forward to the next NNCI Etch Symposium in the summer of 2023 at a location to be announced.

LPCVD Silicon Carbide Now Available

The CNF has reconfigured one of the LPCVD furnaces into an LPCVD silicon carbide deposition tool using dichlorosilane, acetylene, hydrogen and ammonia as the process gases. The tool can deposit doped and un-doped silicon carbide. By adjusting different gas ratios the film stress can be varied from 50 MPa compressive to 500 MPa tensile. Films can be doped with nitrogen using ammonia to reduce the resistivity to 0.1 Ohm-cm. Film deposition rates are in the 30-40 A/min range.

For more information, contact Phil Infante at pi12@cornell.edu.



DARIUS Nanoprober at CNF

Accelerate your tests with the Xallent Nanoprober: DARIUS is designed to make your research and failure analysis as easy as possible. Leveraging Xallent's innovative nano-electro-mechanical-systems (NEMS) and MEMS probes enable material and device characterization at the micro and nanoscale, offering unprecedented throughput, versatility, and ease of use.

DARIUS is programmable and semi-automatic, measuring the electronic properties of thin film materials and electronic devices at the micro and nanoscale inside a scanning electron microscope (SEM) or in ambient air. With its low profile, fast setup, and minimized sample preparation requirement, the DARIUS Nanoprober offers simple, fast, and reliable characterization in many thin film and semiconductor test applications. DARIUS is powered by Xallent's intuitive software suite which maximizes the utility of the Nanoprober.

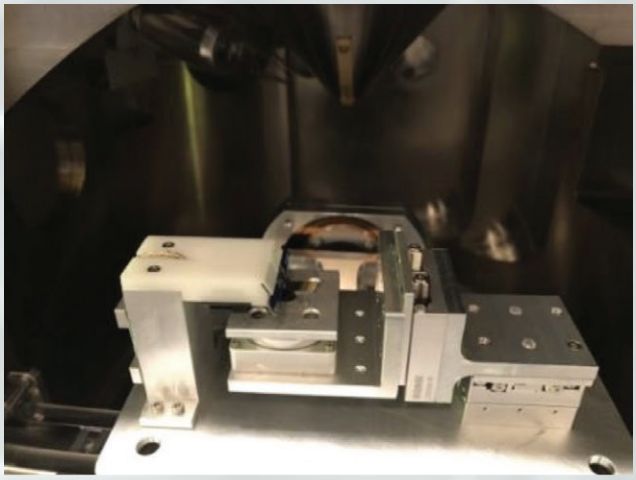
The ability to electrically characterize materials and devices within very confined areas on a routine basis will open up new possibilities for exploration of micro and nanoelectronics. The Xallent DARIUS NanoProber installed at the Cornell NanoScale Facility allows users to directly land probes to test thin films and devices inside an SEM. A video demonstration can be found here [https://youtu.be/Ak4evmCkJTg].

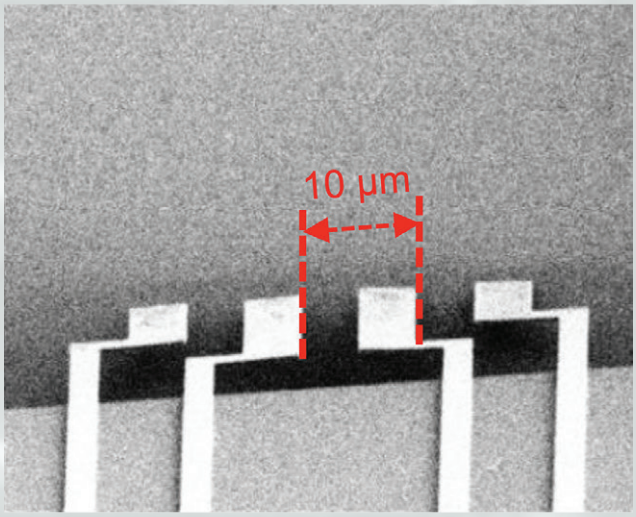
DARIUS could be used for several applications ranging from DC to high frequency measurements. The Nanoprober accepts a portfolio of Xallent probe cards ranging from 4-point probes, force feedback probes, parametric probes, and high frequency probes.

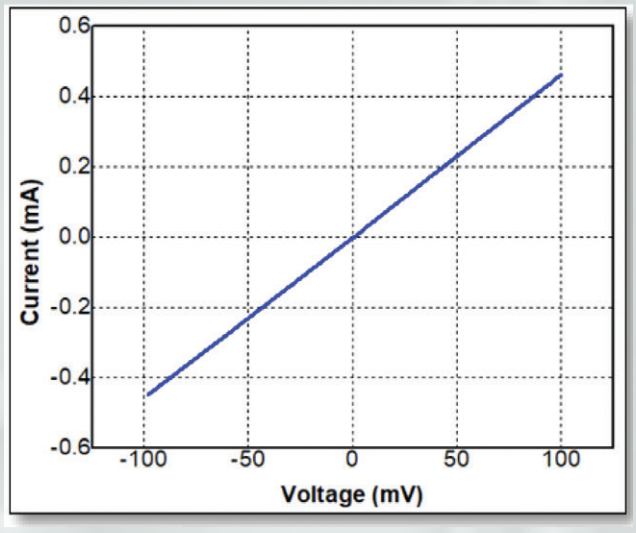
The prober could be used for the following applications:

- **IV, CV, and sheet resistance measurements**
- **Mechanical and scanning probe tests**
- **Force feedback probing**

Please contact Dr. Xinwei Wu at wu@cnf.cornell.edu for training.







3rd Intercampus Cancer Symposium

https://academicintegration.cornell.edu/index.php/news-and-events/events/3rd-annual-intercampus-cancer-symposium

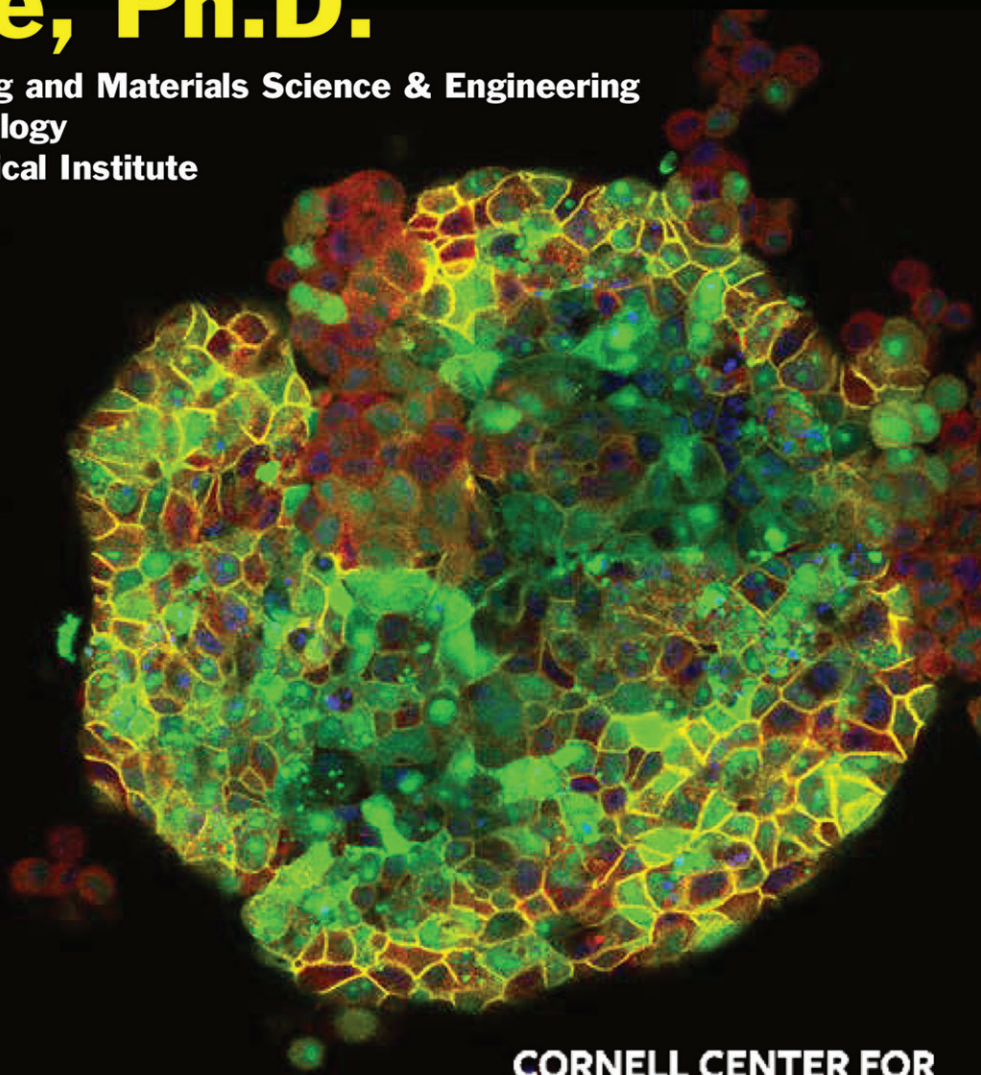
Keynote Lectures:

Sheila A. Stewart, Ph.D.

Gerty T. Cori Professor of Cell Biology & Physiology
Washington University School of Medicine

Darrell Irvine, Ph.D.

Professor of Biological Engineering and Materials Science & Engineering
Massachusetts Institute of Technology
Investigator, Howard Hughes Medical Institute



MAY 19-20 2022

Location:
Cornell College of Veterinary Medicine
Lecture Hall 4

CornellPSOC
Physics of Cancer Metabolism

Cornell University
College of Veterinary Medicine

CORNELL CENTER FOR IMMUNOLOGY

Weill Cornell Medicine
Sandra and Edward Meyer Cancer Center

The 2022 Cornell NanoScale Science & Technology Facility Research Experience for Undergraduates (CNF REU) Program

We are pleased to be hosting six undergraduate students for the 2022 CNF REU Program — in person!

Their project information is online at https://cnf.cornell.edu/education/reu/2022, but please welcome from Top Left to Bottom Right:

Sean Anderson
Electrical Engineering, Morgan State University
CNF REU PI: Prof. Farhan Rana

Rodolfo (Rudy) Cantu
Mechanical Engineering, University of Texas at Austin
CNF REU PI: Prof. Amal El-Ghazaly

Zeinab Ismail
Physics, St. John's University
CNF REU PI: Prof. Sadaf Sobhani

Eryka Kairo
Physics/Biomedical Engineering, Seton Hall University
CNF REU PI: Prof. Warren Zipfel

Rachel Qian
Chemical Engineering, Villanova University
CNF REU PI: Sriramya Nair

Ms. Elisa Simoni
Physics/EE, Rose-Hulman Institute of Technology
CNF REU PI: Prof. James Engstrom

Check out the Latest Nanooze!!

Issue 18 of our youth newsletter, Nanooze, is now available and this one focusses on "ORGANIC LIGHT-EMITTING DIODES" with articles like; What are OLEDS?, OLEDS in your life, Carbon; A most useful atom, and Q&A with Nancy Stoffel, Flexible Hybrid Electronics Engineer!

Check it out online at https://www.nanooze.org/

Copies of Nanooze are FREE for K-12 teachers. Please visit our website for more information, past issues to download, and the form for subscribing to receive Nanooze for your classroom!

The CNF is Inspiring Tomorrow's Scientists Today

CNF has recently resumed in person youth outreach events on the Cornell University Campus.

On Saturday, April 9th we hosted 150 young women scientists for the Expanding Your Horizons event. Expanding Your Horizons (EYH) is a one-day conference designed to stimulate participants' interest in math and science through hands-on activities, provide female scientist role models, and foster awareness of opportunities in math and science-related careers. Students participate in two or three workshops organized by Cornell students and faculty, tour state-of-the-art lab facilities on Cornell's Ithaca campus, connect with peers and mentors, and learn that anyone with a curious mind has what it takes to pursue a future in STEM!

The students came to Duffield Hall Atrium for an introduction to the world of nanotechnology and a virtual tour of our cleanroom facility.

We also handed out copies of our Nanooze magazines and a fun experiment using candy to study microfluidics for attendees to explore while they ate lunch in Barton Hall.

Above: Expanding Your Horizons photographs by CNF staff.

CNF has also been hosting the Tompkins County New Visions Engineering program this year. New Visions Engineering mission is to provide a pre-college engineering experience that authentically explores engineering processes and practices, reveals the scope of engineering endeavors, highlights the impact engineers have on society and prepares participants for an undergraduate engineering program. Under the instruction of David Syracuse, this group of students will visit CNF several times during the school year and will be exploring areas of nanotechnology including microfluidics, materials science, nanorobotics and advanced microscopy. The microscopy visit will be in collaboration with the Cornell Center for Materials Research (CCMR) where the students will examine materials using everything from a magnifying glass to a state of the art tool used for atomic scale imaging at the CCMR facility.

Tom Pennell and New Visions Engineering students explore the unique properties of shape memory alloy materials.

CNF Partners with Ithaca Sciencenter to Bring Nano Exhibit to Town

As part of the celebration of CNF's 45th anniversary, we have brought back the Nano Exhibit to the Ithaca Sciencenter! This exhibit allows budding young scientists to explore various aspects of nanotechnology ranging from nanotechnology in nature to ferrofluids. Nano is an interactive exhibition that engages family audiences in nanoscale science, engineering, and technology. Hands-on exhibits present the basics of nanoscience and engineering, introduce some real world applications, and explore the societal and ethical implications of this new technology. Nano was created by the Nanoscale Informal Science Education Network (NISE Network) with support from the National Science Foundation.

Founded in Ithaca in 1983, the Sciencenter is a nationally recognized museum hosting 100,000 guests per year and reaching over 1.5 million guests worldwide through its traveling exhibitions and outreach programs.

CNF's Youth Outreach & Education Coordinator, Tom Pennell (playing with the exhibit in the photo below right!), will be working with the Sciencenter staff to add interesting new content to the Nano Exhibit, and will host multiple in person events throughout 2022 showcasing the exciting world of nanotechnology — including plans to gather the attendees of the NNCI Annual Conference, which is being held at Cornell University this year, at the Sciencenter for an evening of tiny fun!

Adrienne Testa, above, is the Sciencenter Director of Exhibits & Facilities. "We are excited to have the Nano Exhibit back at the Sciencenter and to work with CNF. We have seen this exhibit at locations around the country and the children really enjoy it."

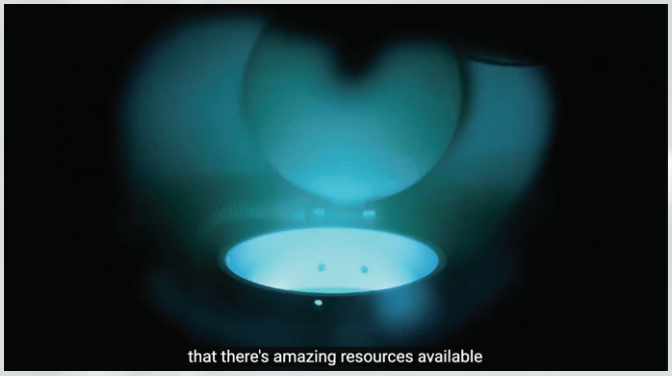
For more information on the Sciencenter please visit: www.sciencenter.org

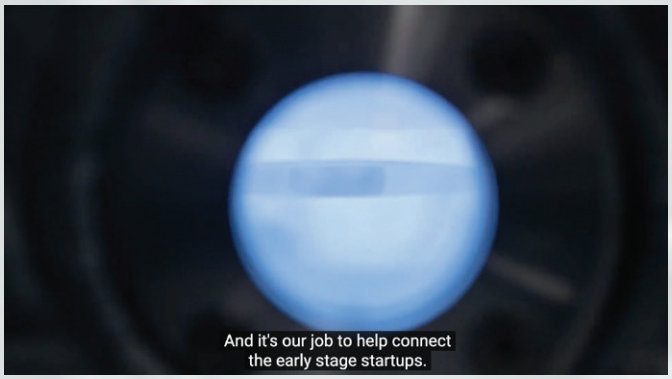
Cornell Leadership Week: Entrepreneurship: Any Person. Any Study. Any Startup.

The CNF took part in the making of a new YouTube video for Cornell Leadership Week, titled "Entrepreneurship: Any Person. Any Study. Any Startup." Find lots of great footage of CNF staff and users in our cleanroom.

https://www.youtube.com/watch?v=bxrJaxK7XPs

See a few screen captures below!





Hernandez wins BRITE Award for Engineered Living Materials

By Syl Kacapyr
March 31, 2022
Cornell Chronicle

Imagine if the walls in your home were alive, and had the ability to sense deterioration and self-repair before cracking.

That's one of the potential applications of engineered living materials, which is the focus of the National Science Foundation BRITE Fellow award received by Christopher Hernandez, professor in Cornell's Sibley School of Mechanical and Aerospace Engineering.

The Boosting Research Ideas for Transformative and Equitable Advances (BRITE) Fellow award, was announced March 31 and comes with $1 million in research funding from the National Science Foundation's Division of Civil, Mechanical and Manufacturing Innovation. The award differs from traditional funding sources by focusing on individual researchers, allowing them to define their own high-risk vision with potentially transformative impact.

Hernandez is one of three researchers in the nation named to the inaugural class of BRITE Fellows.

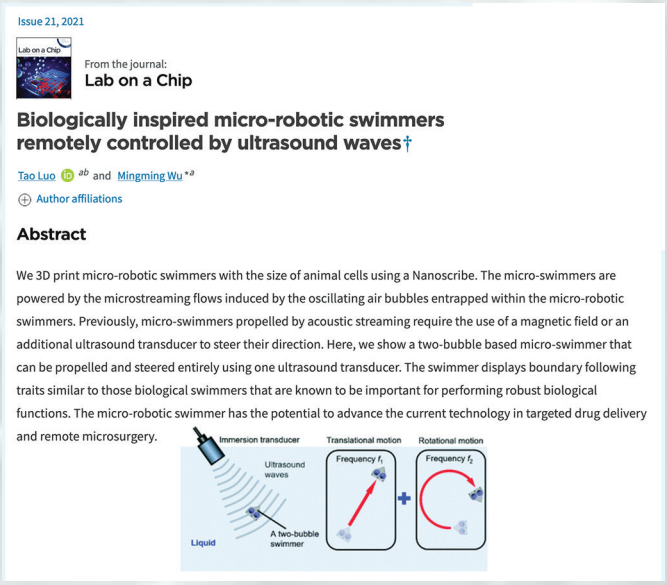
Engineered living materials integrate living organisms such as bacteria, fungi and microalgae to make or maintain the material. And while scientists and engineers like Hernandez are only beginning to establish the foundations of the field, the aim is to create materials that can self-assemble, self-repair or possess other traits that mimic biological functions.

Hernandez and his laboratory are known for their studies of the material properties and remodeling of bone, a naturally occurring, rigid living material. Hernandez will leverage that expertise in the BRITE Fellow award to establish fundamental scientific and design approaches to make engineered living materials rigid enough to be used to make vehicles, buildings and commercial products.

"The BRITE Fellow award will allow our team

to venture outside our expertise and perform curiosity driven investigations in engineered living materials," said Hernandez, who is also an adjunct scientist at the Hospital for Special Surgery. "The field of engineered living materials is currently focused on soft materials and synthetic biology. Our project instead focuses on rigid, load-carrying materials that are more common in civil, mechanical and manufacturing engineering."

Another component of Hernandez's BRITE Fellow award includes building a network of faculty to coordinate mentorship and advocacy for students from groups underrepresented in engineering, with the goal of increasing the national talent pool of scientists and engineers.



Hi Melanie, Tao Luo's paper in *Lab on a Chip* was featured in the back cover.

https://pubs.rsc.org/en/content/articlepdf/2021/lc/d1lc00575h

This paper acknowledges CNF.

Best, Mingming Wu

Congratulations to Reet Chaudhuri — the 2022 Cornell ECE Outstanding Ph.D. Thesis Winner!

January 27, 2022
Jena / Xing News

"I use careful heterostructure design and crystal growths to make high-performance electron- and hole-channel transistors on AlN. A major highlight has been my discovery of the long-missing undoped GaN/AlN 2D holes, which enabled the p-channel III-nitride transistors to break the GHz-speed barrier.

I have co-authored 20+ peer-reviewed journal articles, 20+ conference presentations, 6 invited talks and 4 patents during the course of my PhD. I also co-founded an early-stage start-up Soctera Inc. to commercialize my research on aluminium-nitride (AlN) based high-power RF transistors, performing extensive customer discovery and securing small-business funding from the National Science Foundation."

Congratulations to Prof. Debdeep Jena for Being Recognized a Highly Cited Researcher

November 19, 2021
Jena / Xing News

Each year, Clarivate™ identifies the world's most influential researchers — the select few who have been most frequently cited by their peers over the last decade. In 2021, fewer than 6,700, or about 0.1%, of the world,Äôs researchers, in 21 research fields and across multiple fields, have earned this exclusive distinction.

Prof. Jena is among this elite group recognized for exceptional research influence, demonstrated by the production of multiple highly-cited papers that rank in the top 1% by citations for field and year in the Web of Science™.

Seven Cornell Faculty Awarded Prestigious AAAS Fellowship

By Megan Keller and Jessie Ye, March 9, 2022
The Cornell Daily Sun - Independent Since 1880

This year seven Cornell faculty members were awarded as American Association for the Advancement of Science Fellows, a distinguished group of scientists, engineers and innovators who have been recognized for their achievements across disciplines. From the crossroads of economics and agriculture to Alzheimer's research and engineering, these faculty members display new research that Cornell boasts. AAAS mission statement is to "advance science, engineering and innovation throughout the world for the benefit of all people." This year's fellow selection highlights how much of that innovation is occurring right here at Cornell. Three of the seven are current or past CNF principal investigators.

Prof. Chris Schaffer, biomedical engineering

Schaffer currently runs a lab with Dr. Nozomi Nishimura, biomedical engineering, where they develop optic-based techniques to inspect the dynamic behavior of live cells. Such techniques include building unique microscopes that can observe new types of cells or see deeper into cell tissue. Using this equipment, the majority of his research has involved protein engineering in the context of more fully understanding cellular interactions that drive downstream symptoms of neurological diseases. In one project, his team focused on the underlying mechanism of cerebral blood flow reduction in patients with Alzheimer's disease. They discovered that neutrophils stuck to capillary segments and blocked blood flow in mice models. Other lab studies include spinal cord injury, microvascular stroke and the role of capillary level flow disruptions.

Prof. J.C. Séamus Davis, physics

In 2019, Davis was awarded the James Gilbert White Distinguished Professor Emeritus in the Department of Physics for his groundbreaking contributions to experimental low-temperature and condensed matter physics. Davis has also invented low-temperature spectroscopic STM imaging, which is used to explore surfaces, electronic structures and bulk properties with atomic resolution. Dr. Davis' lab concentrates creating unique instruments that can visualize the physical properties of electronic, magnetic, atomic and space-time quantum matter at the atomic level. His group is a single research group conducting simultaneous studies with labs at three different locations, one at Cornell, the second at The University College Cork and a third at Oxford University.

Prof. Huili (Grace) Xing, electrical and computer engineering department

Xing joined Cornell in 2014 and was appointed as an Associate Dean on Research and Graduate Studies for the College of Engineering in January 2020. Her work has focused on high-performance connector devices, including nitride and oxide materials, low-dimensional materials and quantum materials that act as semiconductors. With this research, she pioneers the synthesis and application of materials that are not naturally found to increase their functionality and speed.

Also! Congratulations to Prof. Xing for being elected a Fellow of IEEE (November 27, 2021) for her contributions to GaN high-electron-mobility transistors.

Four Assistant Professors Win 2022 Sloan Fellowships

By Krishna Ramanujan
February 15, 2022
Cornell Chronicle

Assistant professors Pamela Chang, Antonio Fernandez-Ruiz, Daniel Halpern-Leistner and Peter McMahon have won 2022 Sloan Research Fellowships from the Alfred P. Sloan Foundation. The fellowships support early-career faculty members' original research and education related to science, technology, mathematics and economics. Peter McMahon (pictured above) is a CNF principal investigator:

McMahon's research tackles the physics of computation, and how physical systems can be engineered to perform computation in new ways that provide benefits over current widely used processors. His lab's emphasis is on quantum computation, but he also explores other emerging technologies, including photonic computing and neuromorphic computing.

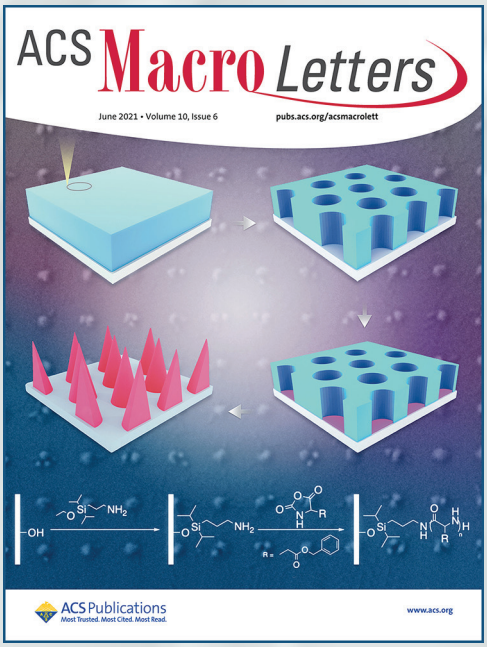
Eleven Professors Win NSF Early-Career Awards

By Tom Fleischman
March 3, 2022
Cornell Chronicle

Researchers studying verification of randomized algorithms, police violence worldwide, polymer nanoparticle synthesis and robotics are among the 11 Cornell assistant and associate professors who have recently received National Science Foundation Faculty Early Career Development Awards. Over the next five years, each will receive approximately $400,000 to $600,000 from the program, which supports early-career faculty "who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization" according to the NSF. The recipients (assistant professors unless noted): Julia Dshemuchadse, Jillian Goldfarb, Bharath Hariharan, Meredith Holgerson, Justin Hsu, Sabrina Karim, Qi Li, Nils Napp, Samitha Samaranayake, Scott Steinschneider, and Rong Yang. Two are CNF principal investigators.

Julia Dshemuchadse, Materials Science and Engineering, will use her award for research that aims to shed light on the self-assembly processes behind the growth of both simple and complex crystal structures ‚Äì specifically, how different particle attachment patterns depend on the symmetry and complexity of crystal structure type, and how they vary with the chemistry of the system. The educational component of this award includes inviting teachers from rural areas in central New York to campus for an annual student-organized summer workshop, and teaching math and science at New York state prisons through the Cornell Prison Education Program.

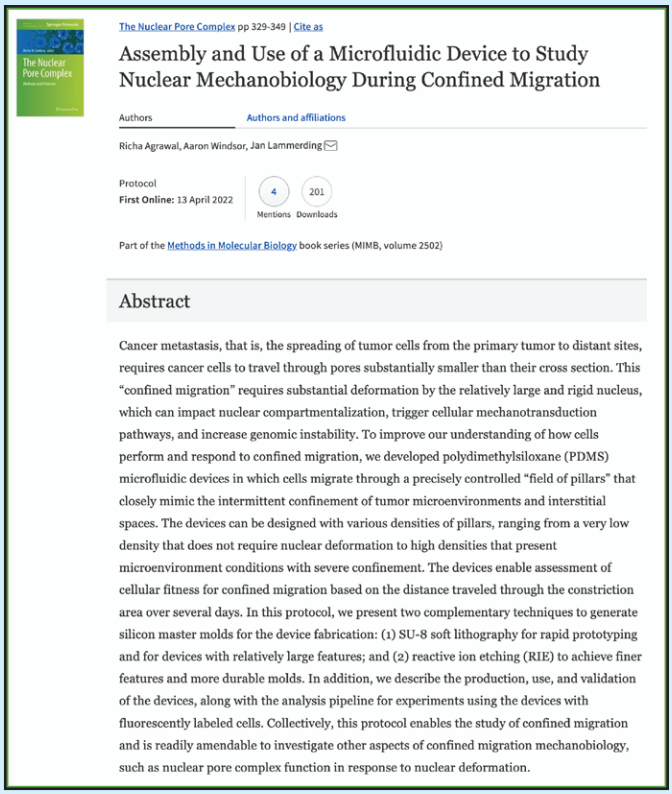
Rong Yang, Chemical and Biomolecular Engineering, will use her funding to support research that enables advances in the manufacturing science of polymer nanoparticles, currently synthesized via a solution-based batch process, which can limit their shape, size, chemistry and, thus, broad deployment. The aim is to develop an all-dry, scalable manufacturing paradigm that produces polymer nanoparticles — with programmable shape, size and chemistries without toxic solvents — that could be used as injectable implants or in drug delivery. The educational component will focus on active learning and broadening the participation of women in STEM entrepreneurship.



Yuming Robin Huang reported that her publication — Huang, Y., Tran, H. & Ober, C.K. High-Resolution Nanopatterning of Free-standing, Self-supported Helical Polypeptide Rod Brushes via Electron Beam Lithography. ACS Macro Letters, 10:755-759 (2021). doi:10.1021/acsami.1c05266 — was featured on a supplementary cover.

2022 has been a very exciting year for CNF staff member Aaron Windsor. First, in February his son Owen was born. Then in April, a publication he co-authored was released. https://link.springer.com/protocol/10.1007/978-1-0716-2337-4_22

Congratulations, Aaron!



The Nuclear Pore Complex pp 329-349 | Cite as

Assembly and Use of a Microfluidic Device to Study Nuclear Mechanobiology During Confined Migration

Authors | Authors and affiliations

Richa Agrawal, Aaron Windsor, Jan Lammerding

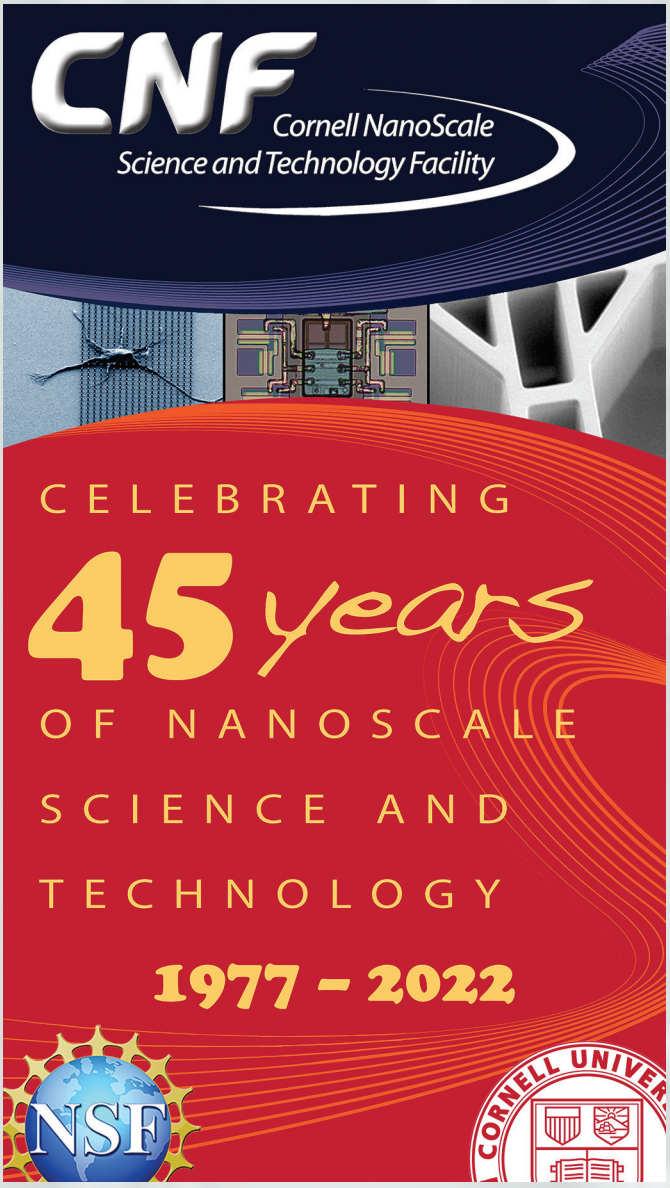
Protocol
First Online: 13 April 2022

4 Mentions | 201 Downloads

Part of the Methods in Molecular Biology book series (MIMB, volume 2502)

Abstract

Cancer metastasis, that is, the spreading of tumor cells from the primary tumor to distant sites, requires cancer cells to travel through pores substantially smaller than their cross section. This "confined migration" requires substantial deformation by the relatively large and rigid nucleus, which can impact nuclear compartmentalization, trigger cellular mechanotransduction pathways, and increase genomic instability. To improve our understanding of how cells perform and respond to confined migration, we developed polydimethylsiloxane (PDMS) microfluidic devices in which cells migrate through a precisely controlled "field of pillars" that closely mimic the intermittent confinement of tumor microenvironments and interstitial spaces. The devices can be designed with various densities of pillars, ranging from a very low density that does not require nuclear deformation to high densities that present microenvironment conditions with severe confinement. The devices enable assessment of cellular fitness for confined migration based on the distance traveled through the constriction area over several days. In this protocol, we present two complementary techniques to generate silicon master molds for the device fabrication: (1) SU-8 soft lithography for rapid prototyping and for devices with relatively large features; and (2) reactive ion etching (RIE) to achieve finer features and more durable molds. In addition, we describe the production, use, and validation of the devices, along with the analysis pipeline for experiments using the devices with fluorescently labeled cells. Collectively, this protocol enables the study of confined migration and is readily amendable to investigate other aspects of confined migration mechanobiology, such as nuclear pore complex function in response to nuclear deformation.



Sperm Switch Swimming Patterns to Locate Egg

"By understanding what determines the navigational mechanism and the biophysical and biochemical cues for a sperm to get to the egg, we may be able to use those cues to treat couples with infertility issues and select the best strategy for in vitro fertilization," said Alireza Abbaspourrad, the paper's senior author and the Youngkeun Joh Assistant Professor of Food Chemistry and Ingredient Technology in the Department of Food Science in the College of Agriculture and Life Sciences.

https://news.cornell.edu/stories/2021/11/sperm-switch-swimming-patterns-locate-egg

Tiny Photonic Chip Provides a Big Boost in Precision Optics

"If you want to measure something with very high precision, you almost always use an optical interferometer, because light makes for a very precise ruler," says Jaime Cardenas, assistant professor of optics at the University of Rochester.

https://scitechdaily.com/tiny-photonic-chip-provides-a-big-boost-in-precision-optics/

Collaboration Gets Quantum View of Superconductor Junction

"We have vastly different electronic systems that are now coexisting in the same materials platform. Knowing more about the interface between these two materials, and the electronic properties at the interface, could allow us to design applications that take advantage of the unique electronic properties of both materials," Wright said. "Sometimes the separation between the states of the two materials is the property we would want. And sometimes we may actually want interaction between the electronic states."

https://news.cornell.edu/stories/2021/12/collaboration-gets-quantum-view-superconductor-junction

Engineers Pave Way for Next-Gen Deep Ultraviolet Lasers

"It is known that this is a material that is suitable, but it was a materials synthesis problem," said Len van Deurzen, a doctoral student in applied and engineering physics who led the research. "The challenge is making the materials pure enough that they're actually going to be useful and sustain the requirements of a laser."

https://news.cornell.edu/stories/2022/04/engineers-pave-way-next-gen-deep-ultraviolet-lasers

Semiconductor Demonstrates Elusive Quantum Physics Model

The project is the latest discovery from the shared lab of Kin Fai Mak, associate professor of physics in the College of Arts and Sciences, and Jie Shan, professor of applied and engineering physics in the College of Engineering, the paper's co-senior authors. Both researchers are members of the Kavli Institute at Cornell for Nanoscale Science.

https://news.cornell.edu/stories/2022/01/semiconductor-demonstrates-elusive-quantum-physics-model

Electrostatic Engineering Gets the Lead Out for Faster Batteries

"Liberating a Hidden Antiferroelectric Phase with Interfacial Electrostatic Engineering," was published Feb. 2 in Science Advances. The senior author is Darrell Schlom, Industrial Chemistry. Julia Mundy, Ph.D. '14 of Harvard University; Bastien Grosso of ETH Zurich; and Colin A. Heikes, Ph.D. '15 of the National Institute of Standards and Technology, Center for Neutron Research, are co-first authors.

https://news.cornell.edu/stories/2022/02/electrostatic-engineering-gets-lead-out-faster-batteries

'Lab on a Chip' can Measure Protein-DNA Interactions

In a new paper, Michelle Wang, Physical Sciences, and her lab demonstrate that their nanoscale device, the nanophotonic standing-wave array trap (nSWAT), can apply enough force to perform a range of standard single-molecule experiments, including: stretching DNA molecules, unzipping DNA molecules, and disrupting and mapping protein-DNA interactions.

https://news.cornell.edu/stories/2022/01/lab-chip-can-measure-protein-dna-interactions

Visiting Journalist: Science Writing is 'good for the world'

Writing about science in easy-to-understand terms "is a good exercise for you and good for the world," award-winning journalist Natalie Wolchover told close to 100 people gathered in Lewis Auditorium on March 15 for her master class on bringing science to life through storytelling. "Clearly, there's a lot of work to do for science communicators to improve literacy and it's an important goal to strive for," she said.

https://news.cornell.edu/stories/2022/03/visiting-journalist-science-writing-good-world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