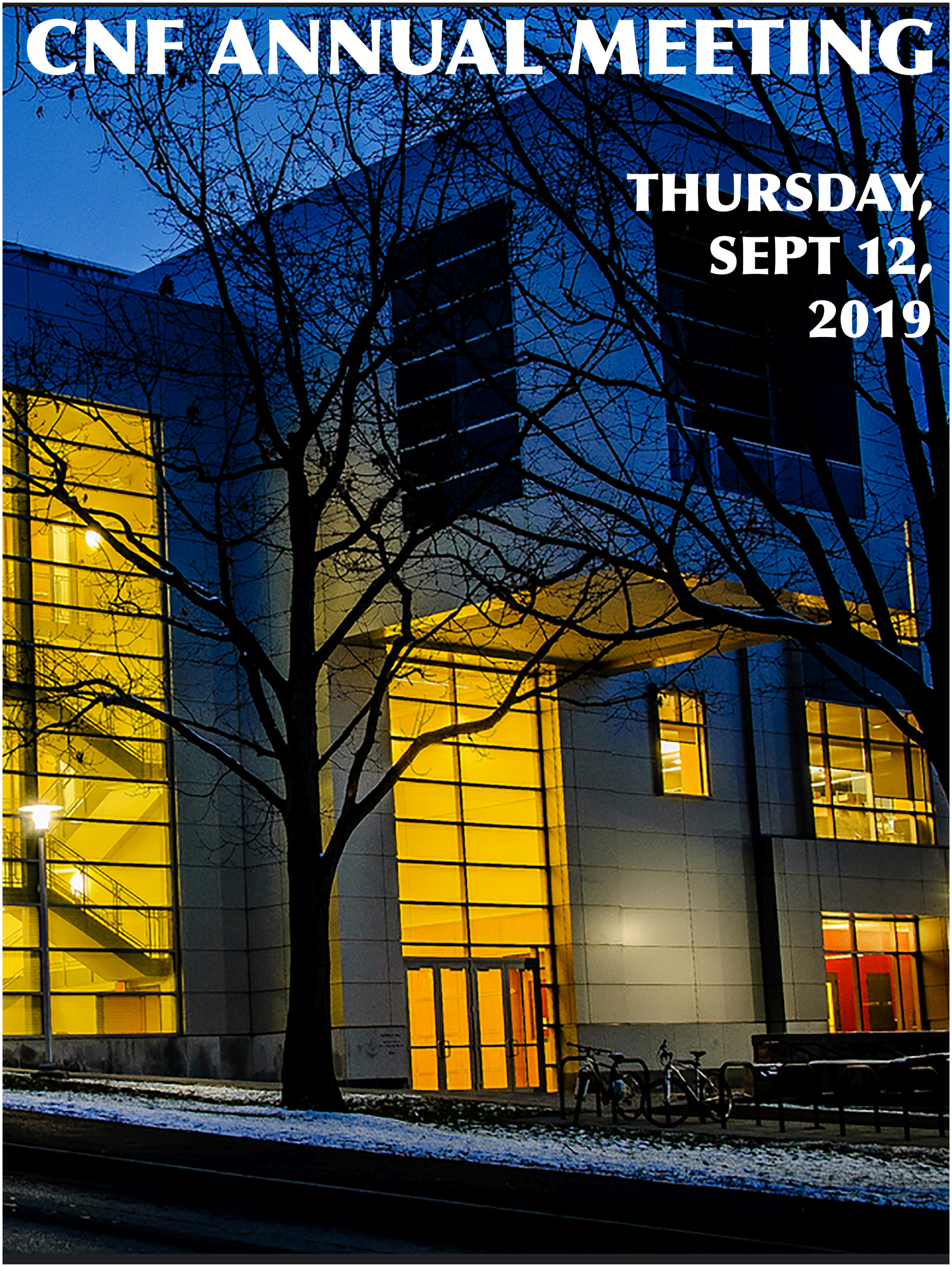
CNF ANNUAL MEETING

THURSDAY, SEPT 12, 2019



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:: 2019 CNF Annual Meeting Schedule ::

Thursday, September 12, 2019

MORNING SESSION

8:00-8:30 a.m. Registration & Hot Breakfast Buffet (Foyer, Biotechnology Building)

8:30-9:00, Welcoming Remarks; CNF Directors (G10 Biotechnology Building)

12:15-1:30, Lunch, Statler Ballroom

AFTERNOON SESSION

Session 3 Chair, Beth Rhoades

2:45-3:00 p.m., Break

Session 4 Chair; Lynn Rathbun

4:10, BREAK for CNF Clean Room Tours / Poster Set-Up

:: Poster Session & Corporate Soiree ::

Duffield Hall Atrium, 5:00-7:00 p.m.

Student Awards will be given out at 6:30 p.m.

(Poster information begins on page XX)

Christopher Kemper Ober

Lester B. Knight Director, CNF

250 Duffield Hall
343 Campus Road
Ithaca, NY 14853-2700
607-255-2329
director@cnf.cornell.edu
http://www.cnf.cornell.edu/

Christopher Ober is the Francis Bard Professor of Materials Engineering, and he is the Lester B. Knight Director of the Cornell NanoScale Facility.

Chris received his B.Sc. in Honours Chemistry (Co-op) from the University of Waterloo, Ontario, Canada in 1978 and his Ph.D. in Polymer Science & Engineering from the University of Massachusetts (Amherst) in 1982. From 1982 until 1986 he was a senior member of the research staff at the Xerox Research Centre of Canada where he worked on marking materials. Ober joined Cornell University in the Department of Materials Science and Engineering in 1986. He recently served as Interim Dean of the College of Engineering. From 2008 to 2011 he was President of the IUPAC Polymer Division and he is an elected member of the IUPAC Bureau Executive, its core governing group. A Fellow of the ACS, APS and AAAS, his awards include the 2013 SPSJ International Award, 2009 Gutenberg Research Award from the University of Mainz, the 1st Annual FLEXI Award in the Education Category (for flexible electronics) awarded in 2009, a Humboldt Research Prize in 2007 and the 2006 ACS Award in Applied Polymer Science. In 2014 he was a JSPS Fellow in Tokyo, Japan and in 2015 he received the ICPST Outstanding Achievement Award.

Ron Olson

Director of Operations

250 Duffield Hall
343 Campus Road
Ithaca, NY 14853-2700
607-255-2329
olson@cnf.cornell.edu
http://www.cnf.cornell.edu/

Ron Olson has over 32+ years of progressive experience as an innovator in fab operations as well as, process and device development. Prior to his new role at CNF, Ron was Manager of the SiC Technology Transfer Team for GE Global Research at SUNY Polytechnic Institute's Power Electronics Manufacturing Consortium (PEMC) where he provided technical direction and facilities/operational excellence for high volume manufacturing for next generation SiC power semiconductor devices. During his tenure at GE he served as Manager of the Wide Band Gap Process Engineering Team and Micro and Nano Fab Operations. Ron was responsible for the SiC engineering development and pilot production operations as well as, management of a 28,000 sq. ft. Class 100 clean room supporting advanced research and development for a diverse range of technologies including: advanced packaging, wide band gap semiconductors, MEMS, photonics, photovoltaics and nanotechnology.

Prior to joining GE in 2005, Ron was a founding member and Director of Fab Operations at Xanoptix, Inc., a start-up company specializing in next generation optical connections. In addition, he has held various Process Development and Engineering positions at Sanders, A Lockheed Martin Company, Quantum, and Raytheon's Research Division and Microwave Device Research Laboratory.

Ron received a Bachelor of Science degree in Physics from Allegheny College and a Master of Science degree in Material Science and Engineering from Northeastern University. He has presented and published papers related to fab operations productivity, fab safety, advanced process development of infrared detectors and low damage etch processes. Ron has been awarded multiple patents for his development efforts in the area of optical interconnect transceivers and manufacturing techniques.

PLENARY SPEAKER

"Building Quantum Processors with Nanoscale Superconducting Circuits"

Britton Plourde, Professor of Physics, Syracuse University

(315) 443-8967 (office) • (315) 443-4719 (lab) • http://plourdelab.syr.edu

Nanoscale superconducting circuits are one of the leading candidates for building a large-scale quantum information processor. There have been significant advances in the performance of superconducting quantum bits (qubits) over the past decade and there is currently rapid progress in the development of systems with up to tens of qubits. I will give an overview of the operation of superconducting qubits and highlight associated fabrication topics, including both materials and uniformity issues related to performance as well as architectural challenges with controlling and reading out a large number of highly coherent quantum circuits at temperatures near absolute zero.

Research Interests

- Experimental investigation of topics in quantum information science with superconducting circuits
- Measurements of vortex dynamics in nanofabricated superconducting structures
- Nanofabrication of superconducting devices at Syracuse and the Cornell NanoScale Facility
- Low-temperature physics

Education

- 2000; Ph.D. Physics, University of Illinois, Champaign-Urbana
- 1995; Master of Science, Physics, University of Illinois
- 1993; Bachelor of Science, Physics with Honors, University of Michigan

Awards & Professional Honors

- IBM Faculty Award, 2011
- NSF CAREER Award, 2006
- Editor-in-Chief, IEEE Transactions on Applied Superconductivity, since 2013

Microfluidics: Designing Encapsulation Platforms & Understanding Sperm Navigational Mechanisms to Improve Assisted Reproductive Technologies

Alireza Abbaspourrad

Food Science, Cornell University

alireza@cornell.edu • (617) 229-9202

In the first part of my talk, I will focus on using emulsion drops generated in microfluidics as templates to fabricate functional polymeric microcapsules and microparticles that respond to a range of environmental stimuli in prescribed ways. In addition, taking advantage of material behaviors at liquid-liquid interfaces enables engineering complex soft materials and encapsulating a wide variety of actives including colorants, vitamins and flavors. I will also discuss few examples of encapsulation and triggered-release systems developed for different applications including food and pharmaceutical industry using conventional encapsulation techniques.

In the second part of the presentation I will demonstrate how we can utilize unprecedented precision offered by microfluidics to study microswimmers and active matters in microenvironments. This high precision has enabled us to study the navigation strategies of mammalian sperm. In the case of marine animals and plants, which release gametes into the sea, the motion of sperm occurs in a vast aquatic environment. In contrast, the fertilization process of mammals happens inside a complex environment known as the "female reproductive tract". The intriguing, multifaceted question is, how do healthy sperm naturally navigate the correct path towards the fertilization site? And concurrently, how does the female reproductive tract select for the best sperm while they move towards the oocyte. Since performing *in vivo* studies to answer these questions is difficult and faces many technical and ethical issues, designing *in vitro* environments using microfluidics that mimic at least one facet of female reproductive tract is vital to address these questions.

Atomic Layer Deposition for Membranes, Metamaterials, and Mechanisms

Author(s): Kyle J. Dorsey [1], Tanner G. Pearson [1], Edward Esposito [2], Sierra Russell [4], Baris Bircan [1], Yimo Han [1], Marc Z. Miskin [2,3,5], David A. Muller [1,3], Itai Cohen [2,3], and Paul L. McEuen [2,3]

CNF Project: 900-00

Project Principal Investigator: Paul McEuen

Affiliations:

[1] School of Applied and Engineering Physics, Cornell University

[2] Laboratory of Atomic and Solid State Physics, Cornell University

[3] Kavli Institute for Nanoscale Science, SUNY Polytechnic Institute

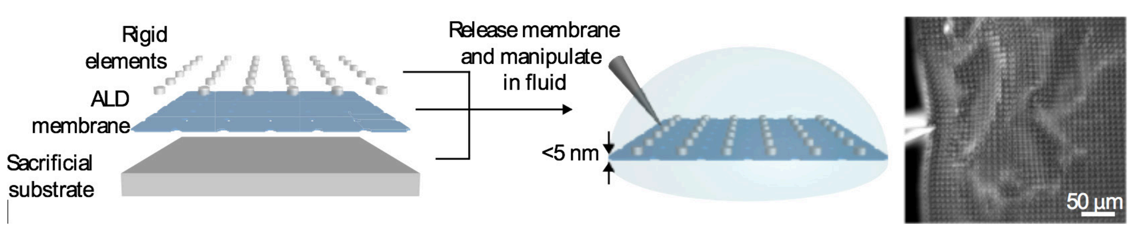
[4] Colleges of Nanoscale Science and Engineering, University of Pennsylvania

[5] Department of Electrical and Systems Engineering, Cornell University

Email: kjd96@cornell.edu

CNF tools: AS200 stepper, Oxford ALD, Arradiance ALD, AJA Sputter, Oxford 80s, PT770, CVC Evaporators, Zeiss SEMs, Veeco AFM, P7 profilometer, Filmmetrics F40

Bending and folding techniques such as origami and kirigami enable the scale-invariant design of 3D structures, metamaterials, and robots from 2D starting materials. These design principles are especially valuable for small systems because most micro- and nanofabrication involves lithographic patterning of planar materials. Ultrathin films of inorganic materials serve as an ideal substrate for the fabrication of flexible microsystems because they possess high intrinsic strength, are not susceptible to plasticity, and are easily integrated into microfabrication processes. Here, atomic layer deposition (ALD) is employed to synthesize films down to 2 nm thickness to create membranes, metamaterials, and machines with micrometer-scale dimensions. Two materials are studied as model systems: ultrathin SiO_2 and Pt. In this thickness limit, ALD films of these materials behave elastically and can be fabricated with fJ-scale bending stiffnesses. Further, ALD membranes are utilized to design micrometer-scale mechanical metamaterials and magnetically actuated 3D devices. These results establish thin ALD films as a scalable basis for micrometer-scale actuators and robotics.



Self-Folding Micro-Origami with Atomic Layer Deposition Bimorph Actuators

Author(s): Baris Bircan, Marc Z. Miskin, Robert J. Lang, Kyle J. Dorsey, Paul L. McEuen, Itai Cohen

CNF Project #: 241616

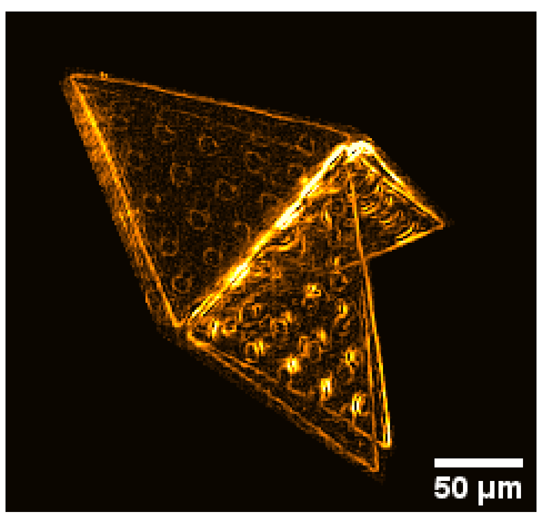
CNF Principal Investigator: Itai Cohen

Department and Institution: Applied and Engineering Physics, Cornell University

Contact Email: bb625@cornell.edu

Primary CNF Tools Used: Oxford ALD FlexAL, SC4500 Evaporator, ABM Contact Aligner, Oxford 81 Etcher, PT770 Etcher, Heidelberg DWL2000 Mask Writer

We present micron sized self-folding structures that consist of nanometer-thin, atomic layer deposited SiO_2-Si_3N_4 bilayers, built with conventional semiconductor fabrication methods. A bending response originating from strain differentials within these bilayer stacks is used for bidirectional fold actuation. This strain differential induced bending is controlled by ion exchange reactions in our nanoscale sheets, enabling us to produce radii of curvature at the order of microns within fractions of a second. By lithographically patterning these sheets and localizing the bending using flat photoresist panels, we create microscale origami devices that can sense chemical changes in their environment and respond by changing configurations according to prescribed mountain-valley fold patterns. Finally, we show that our fabrication approach offers a range of chemical, electrical and biological functions as well as a path to sequential folding through the programming of stacks.



Origami hexagon made with ALD SiO_2-Si_3N_4 bimorph actuators.

Integrated Photonics and 2D Materials

Author(s): Marissa Granados-Baez, Arunabh Mukherjee, A. Nick Vamivakas, and Jaime Cardenas

CNF Project #: 252417
CNF Principal Investigator: Jaime Cardenas
Department and Institution: Optics, University of Rochester
Contact Email: mgranad2@ur.rochester.edu
Web Site: https://www.hajim.rochester.edu/optics/cardenas/
Primary CNF Tools Used: JEOL 9500, ABM Contact Aligner, ASML 300C DUV Stepper

Transition-metal dichalcogenides (TMDCs) are excellent candidates to become efficient optical-gain materials for nanolasers since they present a transition from indirect to direct bandgap when they become monolayer. Until now lasing with TMDCs has been demonstrated in devices challenging to integrate on a chip due to the out of plane emission or suspended cavity geometry.[1] We propose a monolayer TMDC monolithically integrated with a high Q, chipscale silicon nitride microring resonator to enable efficient light emission coupled to an on-chip waveguide. Since the gain threshold for lasing increases proportionally with the number of resonant modes in the cavity, we also propose a ring coupled to a Mach-Zehnder interferometer to increase the free spectral range (FSR) and decrease the total number of modes in the cavity. With both architectures we demonstrate room temperature photoluminescence enhancement of monolayer WSe_2 and MoS_2. The monolayer microring platform enables monolithic, on-chip, waveguide monomode coupled light emission.

References: [1] Youngblood, N. & Mo, L. Integration of 2D materials on a silicon photonics platform for optoelectronics applications. Nanophotonics. 6, 1205–1218 (2016)

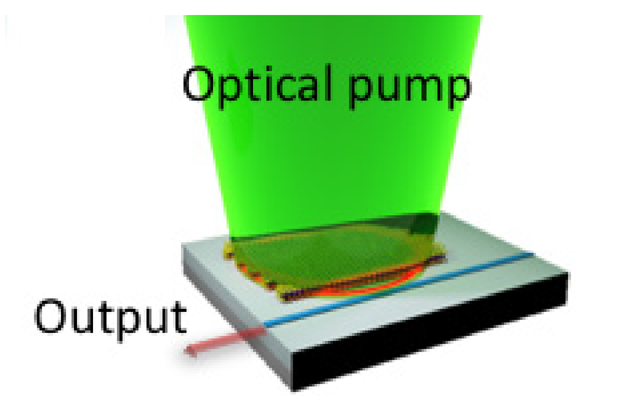


Figure 1. Schematic of the monolyer microring platform for efficient light emission coupled to an on-chip waveguide.

AlN/GaN/AlN HEMTs for High Power, mm-Wave Performance

Author(s): Austin Hickman, Reet Chaudhuri, Samuel James Bader, Kazuki Nomoto, Lei Li, Huili Grace Xing, Debdeep Jena

CNF Project #: 2470-16

Principal Investigator(s): Debdeep Jena, Huili Xing

Affiliation(s): ECE, Cornell University

Email: alh288@cornell.edu, rtc77@cornell.edu, sjb353@cornell.edu, kn383@cornell.edu, grace.xing@cornell.edu, djena@cornell.edu

Primary CNF Tools Used: i-line stepper, e-beam evaporator, AJA sputter, SEM, AFM, Oxford PECVD, Oxford ALD FlexAL, PT770, Oxford 81, glen1000 resist strip, JEOL 6300.

Next-generation radar systems target high-power amplifier operation in the millimeter-wave regime. Gallium nitride high-electron-mobility transistors (GaN HEMTs) are well-suited for this high-power, high-frequency application. However, the conventional AlGaN/GaN heterostructure provides limited confinement of the two-dimensional electron gas (2DEG), and requires a relatively thick top barrier to maintain high 2DEG densities.

To counter these bottlenecks, a HEMT based on aluminum nitride (AlN) has been proposed and fabricated. AlN offers material and device design advantages over the conventional AlGaN/GaN HEMT, such as a larger bandgap buffer and improved thermal conductivity, as well as the ability to scale top barrier thicknesses to less than 5 nanometers.

We recently reported excellent DC characteristics and record small-signal measurements for devices on the AlN platform. This study also takes the first look at off-state breakdown voltage for this heterostructure. The combination of high on current, excellent breakdown, and promising small signal results make a strong case for AlN as a future platform for high-power, mm-wave amplifiers.

Hyperbolic Metamaterial Filter for Angle-independent TM-Transmission in Imaging Applications

Author(s): Golsa Mirbagheri, David Crouse

CNF Project #: 252717

CNF Principal Investigator: David Crouse

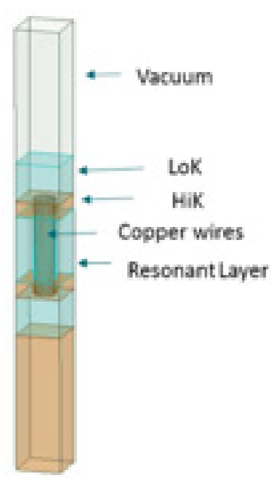
Department and Institution: Electrical and Computer Engineering Department, Clarkson University

Contact Email: mirbagg@clarkson.edu

Primary CNF Tools Used: ASML, Gamma, Oxford 82, Oxford 100, PECVD, Cobra.

In this project we design and fabricate a hyperbolic metamaterials-based narrowband notch filter for the mid-wave infrared regime with an angle-of-incidence independent center-wavelength for TM polarized incident light. To achieve angle of incidence independence, a subwavelength sized array of copper wires is inserted in a vertical orientation and permeates the three middle layers of the seven layers Bragg stack filter. Analysis using Maxwell-Garnett theory and full-wave electromagnetic modeling, and the fabrication progress to date are presented. Narrowband notch filters have applications in optical communications systems, and remote sensors such as hyperspectral sensing and imaging.

Figure 1: The HFSS filter design. The abbreviations LoK and HiK stand for low dielectric material (i.e., SiO_2) and high dielectric material (i.e., a-Si). The resonant layer is composed of SiO_2. The wires only go through the resonant layer and the adjacent two HiK a-Si layers. This is because the fabrication of longer vias proved to be problematic.



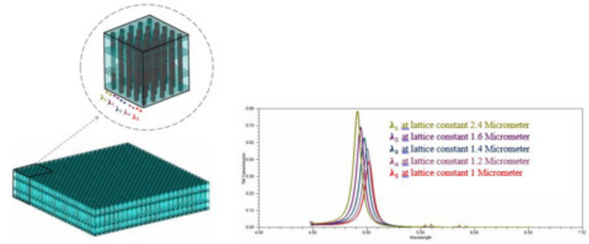


Figure 2: Left: Each pixel of the filter is for separate wavelength. Right: By changing the lattice constant, the wavelength is changing.

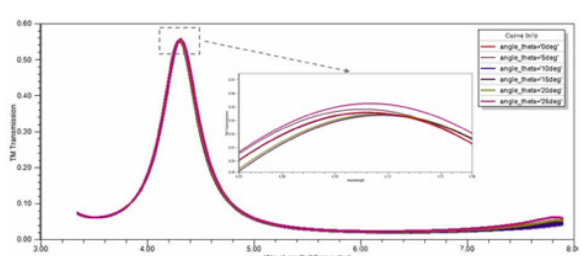


Figure 3: HFSS simulations that show a very small wavelength shift for angle of incidence 0 to 25 degree in the hyperbolic metamaterial Bragg stack (HMBS) filter.

Area-Selective Doping of GaN for the Realization of Vertical Conduction, High Voltage Power Switching Devices

Author(s): Saraf Summer, Richard Brown

CNF Project #: 2620-17
CNF Principal Investigator: Richard Brown
Affiliation: Odyssey Semiconductor, Inc
Email: summer.saraf@gmail.com

To date, GaN devices have been limited to relatively low voltage applications (<1000 V) due to the dominant device architecture being the High Electron Mobility Transistor (HEMT) originally developed for radio frequency applications. These structures are horizontal conduction devices, and since they are grown heteroepitaxially, the defect density in the device films create reliability issues at high voltage operation. To realize vertical conduction devices, area-selective doping needs to be employed to create the device structures as it is with Si and SiC. Currently however, the activation of impurity dopants in GaN has been a challenge due to GaN being unstable at the high temperatures necessary to activate the dopants. We discuss the use of a non-equilibrium annealing technique that has been successful in the activation of dopants in GaN and its use in creating vertical, high voltage power switching devices.

Fiber-Supported Microstructures

Prof. Cindy Harnett

Electrical & Computer Engineering, University of Louisville

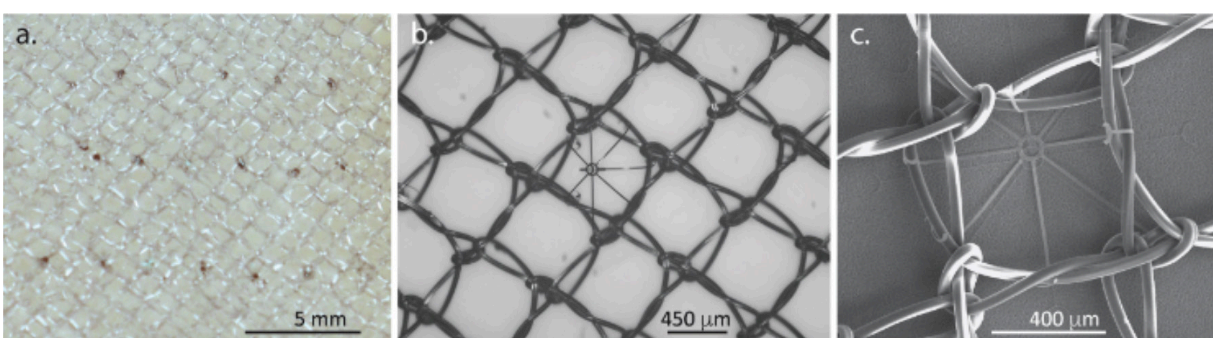
cindy.harnett@louisville.edu • harnettlab.org

Fiber networks can carry out functions that are difficult to achieve in semiconductor devices and microelectromechanical systems (MEMS). Optical waveguiding fibers, nanoporous hollow membranes, conductive freestanding wires, and heat-responsive fiber actuators are some examples. Although semiconductors are now regularly transferred to unconventional substrates in pursuit of flexible and stretchable electronics, fibrous substrates are rarely considered because transfer relies on fine-tuning adhesion forces, putting restrictions on the carrier layer's surface uniformity. In contrast to adhesion, mechanical tangling makes fibrous carrier materials available and provides a route to uniting wafer-fabricated MEMS with functional fibers.

This presentation will review functional fiber projects in my group, including soft robotic mechanisms, magnetic actuators, and stretchable optical fibers placed using automated textile methods, and then discuss a MEMS-to-fiber transfer method based on a highly selective silicon etch process. The resulting MEMS structures pass from one side of a fiber mesh to the other, which is difficult to achieve on continuous thin films of other soft materials like silicone or polyimide. Our process creates large arrays of redundant mechanical contacts between MEMS and a wide variety of fibers. The presentation will conclude with our current work on creating fiber networks specifically for pairing with MEMS.

Dr. Harnett received a Ph.D. in Applied and Engineering Physics from Cornell University in Dr. Harold Craighead's lab studying integration of nanomaterials into microfabricated systems. After a postdoc working on electron beam lithography in collaboration with Dr. Geoffrey Coates at Cornell, she joined the staff of Sandia National Laboratories, working in the Microfluidics and Advanced Microsystems groups, then moved to the University of Louisville Electrical and Computer Engineering department.

Dr. Harnett was the 2001 recipient of the CNF Nellie Yeh-Poh Lin Whetten Memorial Award.



Images - Fabric mesh with transferred MEMS grippers. a), b) - Optical images of a device array on a fabric mesh (a) and a single device in the array center (b). Electron micrograph of a single transferred device (c).

GaN-Based High Electron Mobility Transistors for Next-Generation Communication Systems

Author(s): K. Nomoto 1, J. Miller 1, Z. Hu 1, W. Li 1, A. Hickman 1, K. Lee 1, S. Bader 1, L. Li 1, D. Jena 1,2,3, H. G. Xing 1,2,3

CNF Project #: 280019

CNF Principal Investigator: Huili Grace Xing

Department and Institution: 1 ECE, 2 MSE, and 3 Kavli Institute for Nanoscience, Cornell University

Contact Email: kn383@cornell.edu

Primary CNF Tools Used: i-line Stepper, Heidelberg Mask Writer DWL2000, P7 Profilometer, FilMetrics, AFM Veeco Icon, Zeiss SEM, PT770, Oxford 81, Oxford PECVD, Oxford ALD, Odd-hour Evaporator, AJA Sputter Deposition, RTA AG610, JEOL9500

We report the fabrication and DC and RF characteristics of fully passivated InAlN/GaN high-electron mobility transistors (HEMTs) on Si substrates with balanced f_T and f_{MAX} (144/141 GHz). The InAlN/AlN/GaN HEMT structure consists of a 10 nm $In_{0.17}Al_{0.83}N$ barrier, a 1 nm AlN spacer (total barrier thickness: 11 nm), a 800 nm unintentionally doped GaN channel, and AlGaN/AlN buffer and nucleation layers on a 6-inch Si substrate, grown by a Propel® HVM MOCVD system at Veeco Instruments. Room temperature Hall-effect measurements prior to device fabrication showed a 2DEG sheet concentration of $2.4x10^{13}/cm^2$ and electron mobility of 1310 $cm^2/V·s$, corresponding to a sheet resistance of 196 Ω/sq. A schematic cross-section of the InAlN/AlN/GaN HEMT device with regrown n^+ GaN contacts is shown in Fig. 1. The device fabrication process started with patterning of a SiO_2 mask for n^+GaN ohmic regrowth by PA-MBE. The regrown n^+GaN was 100 nm with a Si doping level of $7x10^{19}/cm^3$. Non-alloyed ohmic contact of Ti/Au/Ni was deposited by e-beam evaporation. T-shaped Ni/Au (40/200 nm) gates were formed by electron-beam lithography, followed by liftoff. The devices were finally passivated by a 50 nm PECVD SiN_x. The device presented here has a regrown n^+GaN source-drain distance of 800 nm, a gate width of 2x25 µm, and a gate length of 87 nm. The device has a saturation drain current = 2.48 A/mm and an on-resistance = 1.07 Ω·mm extracted at V_{gs} = 1 V. A peak extrinsic transconductance is ~0.45 S/mm at V_{ds} = 5 V. The extrapolation of both $|h_{21}|^2$ and U with -20 dB/dec slope gives the current gain cutoff frequency/maximum oscillation frequency f_T / f_{MAX} of 144/141 GHz after de-embedding. The f_T and f_{MAX} of the device are summarized in Fig. 2. Fig. 2 shows how the results of this device compare with the early state-of-art results of GaN HEMTs on Si substrates.

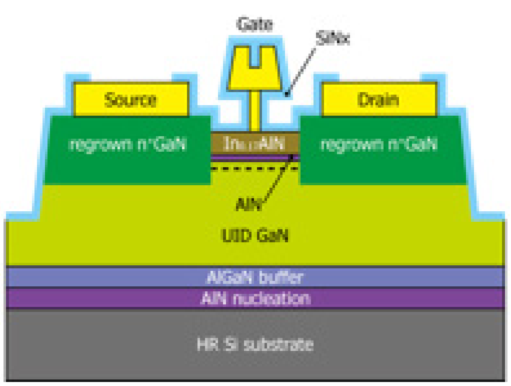
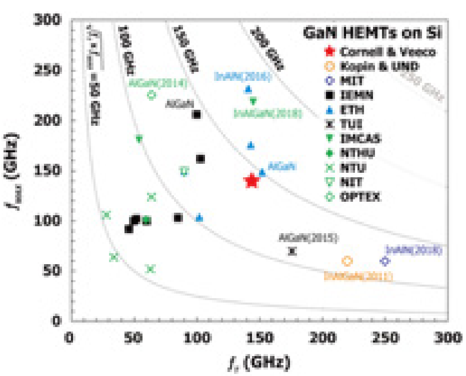


Fig. 1, left. Schematic cross-section of fully passivated InAlN/AlN/GaN HEMTs on Si. Fig. 2, right. Comparison of the measured f_T and f_{MAX} of GaN HEMTs on Si substrates.



A Pull-in Free MEMS Microphone

Author(s): Mehmet Ozdogan, Shahrzad Towfighian, Ronald Miles

CNF Project #: 244616

CNF Principal Investigator: Shahrzad Towfighian, Ronald Miles

Department and Institution: Mechanical Engineering, Binghamton University SUNY

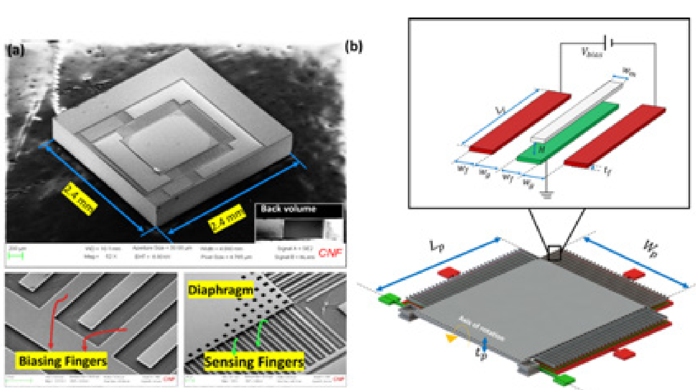
Contact Email: mozdoga1@binghamton.edu

Web Site: https://www.binghamton.edu/labs/mems/

Primary CNF Tools Used: LPCVD N+/P+ Polysilicon -Wet Oxide-CMOS Nitride, MOS Clean Anneal, Heidelberg Mask Writer - DWL2000, AS200 i-line stepper, Versaline Deep Si Etcher, Oxford 80+ and Oxford 100 Etchers, Oxford PECVD, Zeiss Ultra SEM, Dicing Saw, Leica Critical Point Dryer

In this study, we present a MEMS capacitive microphone that is using a levitation based electrode configuration. This particular electrode scheme has been proved to be pull-in (snap-down) safe [1] which enables MEMS devices to properly function at high DC loads [2]. This method uses the fringe electrostatic field to generate a net force that pushes away the moving electrode from the substrate. Thus, with this biasing method the pull-in instability is fully eliminated. The microphone has ~1 mm^2 surface area and 2 µm thick polysilicon diaphragm that can rotate in response to incoming sound waves, Figure 1. After the fabrication of the microphone, they are tested in an acoustic room. The capacitive sensing is achieved using moving and fixed electrodes that are separated with 2 µm air gap. The electronic output of the microphone is obtained using a charge amplifier circuit. The acoustic sensitivity of the device is measured to be 16.1 mV/Pa at 200V bias and the bandwidth is 100 Hz to 4.9 kHz. Our experiments and simulations show that it is possible to create robust sensors that can work properly at high DC voltages (200 V) which is not feasible for most of the MEMS devices using conventional parallel plate electrode design. Besides, larger bias voltages will lead to higher signal-to-noise ratio (SNR) MEMS sensors by decreasing the noise level of ASIC circuits.

References: 1. S. He and R. B. Mrad, "Design, Modeling, and Demonstration of a MEMS Repulsive-Force Out-of-Plane Electrostatic Micro Actuator," in Journal of Microelectromechanical Systems, vol. 17, no. 3, pp. 532-547, June 2008. doi: 10.1109/JMEMS.2008.921710. 2. Towfighian S, He S, Ben Mrad R. A Low Voltage Electrostatic Micro Actuator for Large Out-of-Plane Displacement. ASME. IDETC/CIE, Volume 4: 19th Design for Manufacturing and the Life Cycle Conference; 8th International Conference on Micro- and Nanosystems. doi:10.1115/DETC2014-34283.



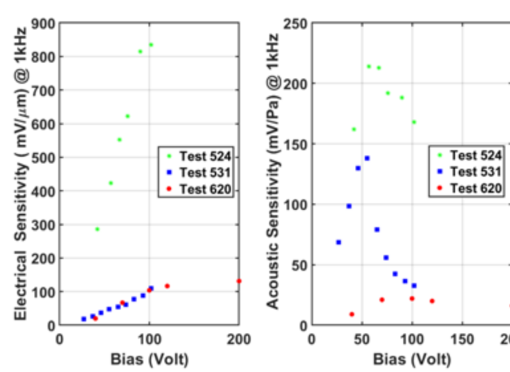


Figure 1, left: (a) SEM Image of the fabricated MEMS microphone. (b) Levitation based electrode configuration. Figure 2, right: Experimental results for three different chips.

Fully Transparent Oxide Thin-Film Transistor with Record Current and On/Off Ratio

Author(s): Jisung Park, Hanjong Paik, Debdeep Jena, Huli Grace Xing, and Darrell G. Schlom

CNF Project #: 254317

CNF Principal Investigator: Darrell G. Schlom

Department and Institution: Materials Science and Engineering, Cornell University

Contact Email: gp359@cornell.edu

Primary CNF Tools Used: Autostep i-line Stepper, PVD 75 Sputter Deposition, PT720-740 Etcher

Here we report making a fully depleted submicron-scale BaSnO3-based fully transparent TFT that sources over 0.435 mA/µm of current with an on/off ratio over 1.5×10^8. This progress has been achieved by depositing stable thin films of transparent oxide semiconductors with high mobility and overcoming the difficulty in patterning them into high-performance TFTs. Further scaling of these TFTs is expected to provide performance rivaling today's most advanced and scaled transistors. Our results demonstrate the tremendous potential of $BaSnO_3$ for the future of transparent oxide electronics.

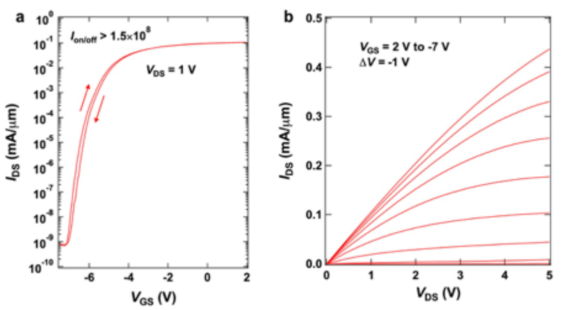


Figure 1: Thin-film transistor based on La-$BaSnO_3$. a, The transfer characteristic of the TFT at V_{DS} = 1 V. The on-off ratio is over 1.5×10^8. The subthreshold swing is around 0.1 V dec^{-1}. b, The output characteristic of the device at V_{GS} = 2, 1, 0, -1, -2, -3, -4, -5, -6, -7 V. The maximum drain current exceeds 0.435 mA/µm.

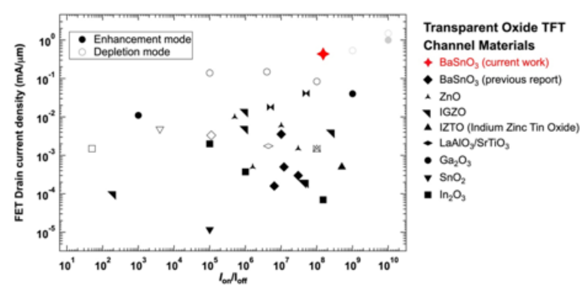


Figure 2: Comparison of drain current in TFTs with transparent oxide channels with respect to on/off current ratio. The drain current of the $BaSnO_3$ TFT is the highest value among scalable all transparent oxide channel field-effect transistors. The solid symbols represent enhancement-mode TFT devices and the hollow symbols represent depletion-mode TFT devices. The top right corner is the desired corner of the plot for the best TFT performance.

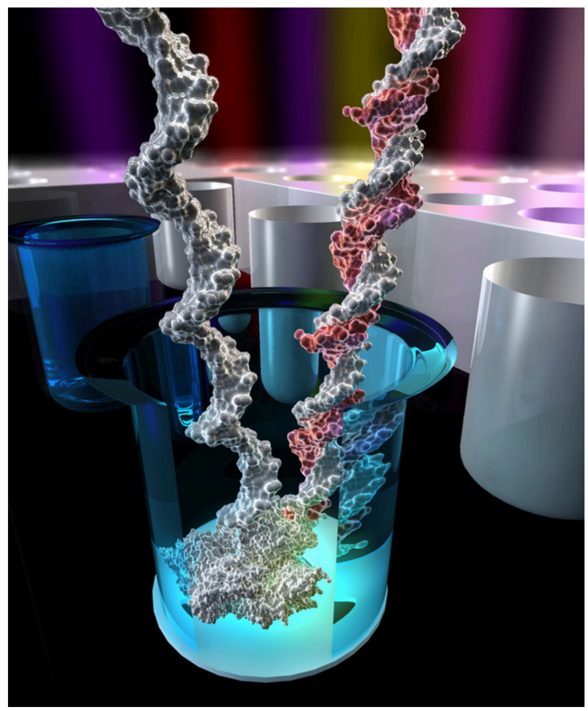
Nanotechnology for Pushing the Limits of Single-Molecule DNA Sequencing: DNA Capture and Sequencing Using Nanopore-Coupled Zero-Mode Waveguides

Meni Wanunu

Physics and Chemistry/Chemical Biology,
Northeastern University

wanunu@gmail.com • www.neu.edu/wanunu

We are developing a new platform for high-throughput single molecule, real-time (SMRT) sequencing of DNA and RNA molecules. The system integrates the familiar zero-mode waveguides (ZMWs), optical wells in which single-dye fluorescence signals are acquired during DNA replication, with pore-containing membranes, which allow electrophoretic molecular focusing of charged analytes into the ZMWs for subsequent interrogation. We observe in interesting packaging process of DNA into the waveguides, length dependence, and anomalously long residence times, which we attribute to entanglement of the DNA inside the ZMWs. We also have developed porous layers for scaling up the ZMW fabrication, which results in even higher capture rates that allow us to obtain pg-level DNA sequencing.



Time permitting, I will also mention other ongoing nanotechnology-related projects we are currently involved with in my lab.

References:

Larkin et al., Length-Independent DNA Packing into Nanopore Zero-Mode Waveguides for Low-Input DNA Sequencing, Nature Nanotechnology (2017).

Jadhav et al., Porous Zero-Mode Waveguides for Picogram-Level DNA Capture, Nano Letters (2019).

Ultralow Power NEMS Wakeup Radio Receiver & A Pathway for AI in the Cleanroom

Author(s): Alexander Ruyack, Benyamin Davaji, Landon Ivy, Leanna Pancoast, Nabil Shalabi, Alyosha Molnar and Amit Lal

CNF Project #: 126204

CNF Principal Investigator: Amit Lal

Department and Institution: Electrical & Computer Engineering, Cornell University

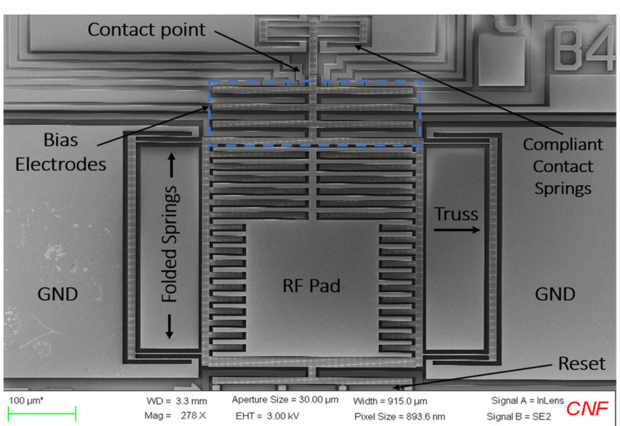
Contact Email: arr68@cornell.edu

Primary CNF Tools Used: ASML 300C DUV Stepper, Zeiss Ultra & Supra SEMs, Oxford 81 & 82 Etchers, Oxford 100 Etcher, Hamatech Hot Piranha, Primaxx Vapor HF Etcher, Plasma-Therm Deep Si Etcher, Dicing saw – Disco, Wire Bonder, Zygo, Furnaces, ResMap, Nanostrip Bath

With the advent of RF connectivity between sensors and the subsequent proliferation of wireless sensor nodes, power consumption and battery management of distributed sensor networks has become a bottleneck for widespread implementation. With applications spanning smart cities, agricultural monitoring and military scenarios, replacing batteries is becoming costly and time consuming while potentially dangerous if involving sensors in remote locations. Beyond advancements in battery technology and power reduction of active components, asleep-yet-aware sensors provide a means for reducing power consumption and significantly extending sensor node lifetime. These sensors consume zero or near-zero power and have targeted signals of interest, using their output to wake up higher power electronics for communication or signal processing. Having the ability to wake a sensor node by radio frequency (RF) outside of these signals of interest would be invaluable, enabling device poling, data retrieval or active sensor monitoring at will.

In order to implement this device, inspiration is taken from a low sub-threshold current and low switching energy NEMS switch. From this, we demonstrate a near-zero power laterally actuated NEMS electrostatic RF receiver. The receiver is operated by biasing a mechanical gap close to physical contact where the addition of an RF signal acts to completely close the device, like a switch. Focused ion beam (FIB) is utilized to achieve a sub-100nm platinum contact gap, allowing for < 1.5V DC operation and improved reliability. RF sensitivity is shown approaching 40dBm for a receiver operating off resonance in a custom vacuum probe station. Average power consumption is shown to be below 10fW with peak power consumption during a triggering event reaching 150fW.

While FIB proved successful in creating small gaps for our devices, it is long term unsustainable and impractical for commercialization. The last part of this talk will touch on current efforts to use AI in the CNF to achieve consistent tool specification limit results. Machine learning can enable this invariant of environmental effects, tool recalibration or age and account for graduate student variability. The overall hope is to reduce the cost and effort of the process development cycle to achieve specific structures by suggesting AI produced recipes.



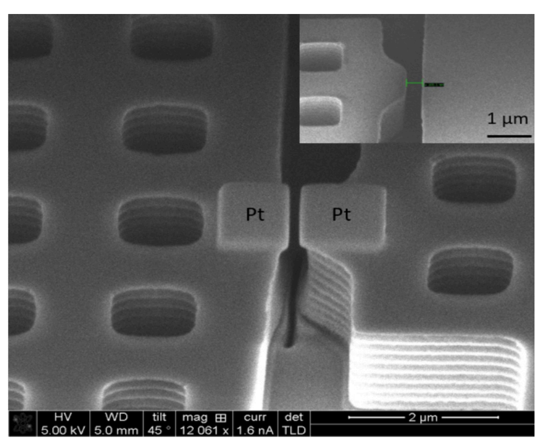


Figure 1, left: SEM micrograph of fabricated device. Pertinent device components are indicated and labeled. The device consists of a variety of electrostatic forcing electrodes, a released/moving shuttle, and a contact point. Figure 2, right: SEM micrograph of unreleased device with Pt FIB contact. Pt contacts on both the shuttle and contact are shown after deposition and patterning. Inset is an untreated device showing ~300 nm natural gap.

Parallel Unzipping of DNA Molecules using Nanophotonic Tweezers

Authors: Fan Ye, James T. Inman, and Michelle D. Wang

CNF Project #: 173808

CNF Principal Investigator: Prof. Michelle D. Wang

Department and Institution: Department of Physics, Cornell University

Contact Email: fy72@cornell.edu

Primary CNF Tools Used: ASML Deep Ultraviolet Stepper, Oxford 100 Plasma Etcher, Unaxis 770 Deep Si Etcher, Heidelberg Mask Writer DWL2000, SUSS MA6-BA6 Contact Aligner, Gamma Automatic Coat-Develop Tool, LPCVD Nitride - B4 furnace, Wet/Dry Oxide - B2 furnace, AJA Sputter Deposition, CVC Sputter Deposition, GSI PECVD, Oxford PECVD, SC4500 Odd-Hour Evaporator, Zeiss Supra/Ultra SEM

Optical trapping has become a major technique widely used in biological and materials sciences, on size scales ranging from the single molecule to the cellular level, and force scales ranging from sub piconewton (pN) to tens of pN [1]. The rapid development of nanofabrication techniques in the past few decades has bolstered the emergence of nanophotonic evanescent-field traps. The ability of nanostructures to direct and confine light beyond the diffraction limit enables miniaturized, on-chip devices with abilities beyond traditional microscope-based optical tweezers [2]. The Wang lab has developed and implemented such an on-chip device based on Si or Si_3N_4 waveguides, coined a nanophotonic standing-wave array trap (nSWAT), that allows for controlled and precise manipulation of trapped single biomolecule (such as DNA) arrays via microparticle handles [3-6]. We present here the latest development of the nSWAT platform design that achieves large enough manipulation forces for unzipping an array of DNA molecules. This benchmark achievement is one step closer to the full realization of nanophotonic tweezers' capabilities, promising increased accessibility and expansion of these platforms to a wide range of biological and biomedical research topics.

References: [1] J. Killian, F. Ye, M. Wang, Cell 175, 1445-1448 (2018). [2] J. Baker, R. Badman, and M. Wang, WIREs Nanomed Nanobiotechnol. e1477 (2017). [3] M. Soltani, J. Lin, R. Forties, J. Inman, S. Saraf, R. Fulbright, M. Lipson, and M. Wang, Nature Nanotechnology 9, 448-452 (2014). [4] F. Ye, R. Badman, J. Inman, M. Soltani, J. Killian, and M. Wang, Nano Letters 16, 6661-6667 (2016). [5] F. Ye, M. Soltani, J. T. Inman, and M. D. Wang, Optics Express 25 (7) 7907-7918 (2017). [6] R. Badman, F. Ye, W. Caravan, and M. D. Wang, ACS Appl. Mater. Interfaces 11, 25074-25080 (2019).

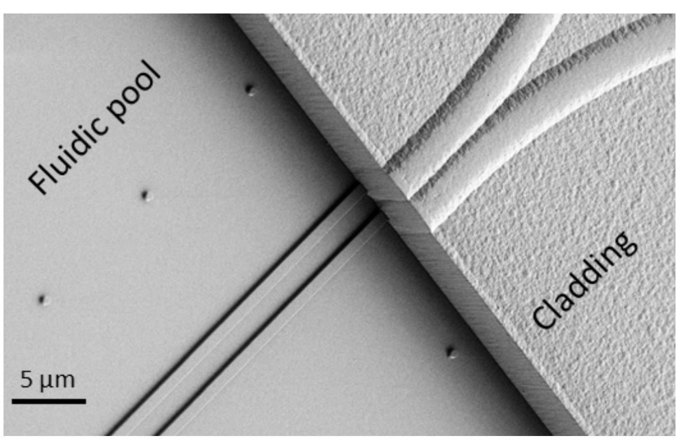


Figure 1. SEM image of an nSWAT device.

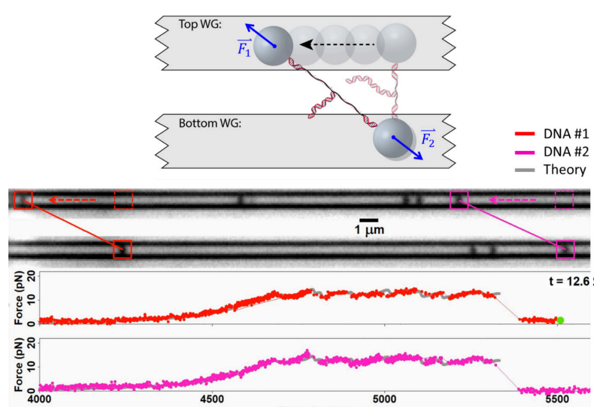


Figure 2. Parallel unzipping of DNA molecules by an nSWAT device with a schematic illustration inset.

:: Poster Information ::

in order of Poster Number

CENTER POSTER #1

Biotechnology Resource Center

Authors: James VanEe, Jarek Pillardy, Peter Schweitzer, Rebecca Williams, Sheng Zhang
Affiliation: Cornell University Institute of Biotechnology
Email address: brc_director@cornell.edu

CENTER POSTER #2

BRC Imaging Facility

Author(s): Teresa Porri, Tina Abratte, Carol Bayles, Johanna Dela Cruz, Rebecca Williams
Principal Investigator: Rebecca Williams
Affiliation(s): Cornell University Institute of Biotechnology, Biotechnology Resource Center Imaging Facility
Email: tp252@cornell.edu, rw36@cornell.edu

CENTER POSTER #3

Center for Technology Licensing at Cornell

Author(s): Ryan Luebke
Affiliation(s): Cornell Research Division
Email: RTL77@Cornell.edu

CENTER POSTER #4

MacCHESS/CLASSE; Serving Structural Biology: Recent Developments at a Synchrotron Source

Author(s): I. A. Kriksunov, R. Cerione,
M. Cook, R. Gillilan, A. Finke, Q. Huang, W. Miller, D. Rai, D.
Schuller, and D. M. E. Szebenyi
Principal Investigator: D. M. E. Szebenyi
Affiliation(s) (Department, Institution/Corporation): Macromolecular X-ray science at the Cornell High Energy Synchrotron Source (MacCHESS), Cornell Laboratory of Accelerator-Based Sciences and Education (CLASSE)
Email: ik29@cornell.edu, dms35@cornell.edu

CENTER POSTER #5

CNF Fellows Program; Patterning metallic films with block copolymer lithography

CNF Project # CNF Fellows Program
Author(s) Tanner G. Pearson1, Kyle J. Dorsey1, Alexander R. Ruyak2, Alan R. Bleier3 and Vince Genova3
Principal Investigator(s) Alan R. Bleier3 and Vince Genova3
Affiliation(s) 1School of Applied and Engineering Physics, Cornell University, 2School of Electrical and Computer Engineering, Cornell University, 3Cornell NanoScale Science and Technology Facility, Cornell University
Email tgp34@cornell.edu, kjd96@cornell.edu, arr68@cornell.edu, bleier@cnf.cornell.edu, genova@cnf.cornell.edu
Primary CNF Tools Used ABM contact aligner, Oxford 100, PT 740/770, Zeiss SEM, Oxford FlexAL

1 Wang Poster Info

Synthesis of semi-dilute SiO_2-Polystyrene (PS) hairy nanoparticles (PGNs)

CNF Project 175709
Author(s) Yinglu Wang
Principal Investigator Christopher Ober
Affiliation(s) Chemistry and MSE
Email yw973@cornell.edu, cko3@cornell.edu

2 Deng Poster Info

Scissionable polymer photoresist for EUV Lithography

CNF Project # 275118
Author(s) Jingyuan Deng, Yiren Zhang, Abhaiguru Ravirajan, Christopher K. Ober.
Principal Investigator Chris Ober.
Affiliation(s) Department of Material Science and Engineering.
Email jd966@cornell.edu, cko3@cornell.edu
Primary CNF Tools Used: Contact aligner.

3 Lee (Sunwoo) Poster Info

Injectable Microscale Optoelectronically Transduced Electrodes (iMOTEs)

CNF Project # 257817
Author(s) Sunwoo Lee, Alejandro J. Cortese, Paul L. McEuen, Alyosha C. Molnar
Principal Investigator Alyosha C. Molnar
Affiliation(s) Electrical and Computer Engineering, Department of Physics
Email sl933@cornell.edu / am699@cornell.edu

4 Lee (Kevin) Poster Info

Efficient InGaN p-Contacts for deep UV Light Emitting Diodes

CNF Project # 280119
Author(s) Kevin Lee, Shyam Bharadwaj, Vladimir Protasenko, Huili Grace Xing and Debdeep Jena
Principal Investigators Huili Grace Xing and Debdeep Jena
Affiliation(s) School of Electrical and Computer Engineering, Cornell University
Email kl833@cornell.edu, grace.xing@cornell.edu, djena@cornell.edu

5 Ravirajan Poster Info

Scissionable polymer photoresist containing PAG for EUV Lithography

CNF Project # 275118
Author(s) Abhaiguru Ravirajan, Jingyuan Deng, Yiren Zhang
Principal Investigator Christopher Ober
Affiliation(s) Chemical and Biomolecular Engineering, Cornell University
Email ar2362@cornell.edu, jd966@cornell.edu, yz779@cornell.edu, christopher.ober@cornell.edu

6 Schaefer Poster Info

Graphene Hall sensors and magnetic imaging of van der Waals superconductors

CNF Project # 236115, 251416
Author(s) Brian T. Schaefer, A.Jarjour, L.Wang, M.Lee, T.Taniguchi, K.Watanabe, P.L. McEuen, K.C. Nowack
Principal Investigator Katja Nowack
Affiliation(s) Cornell University Laboratory of Atomic and Solid-State Physics
Email bts72@cornell.edu, kcn34@cornell.edu

7 Liu (Yutong) Poster Info

Optical Measurements of ultrasonic Fourier transforms

CNF Project # 1121-0
Author(s) Yutong Liu, Mamdouh Abdelmejeed, Justin Kuo, and Amit Lal
Principal Investigator Amit Lal
Affiliation(s) ECE, Cornell
Email yl2724@cornell.edu, amit.lal@cornell.edu
Primary CNF Tools Used: Dicing saw, wire-bonder

8 Hickman Poster Info

High Power AlN/GaN/AlN HEMTs for 140, 220, 340 GHz

CNF Project # 2470-16
Author(s) Austin Hickman, Reet Chaudhuri, Samuel James Bader, Kazuki Nomoto, Huili Grace Xing, Debdeep Jena
Principal Investigator Debdeep Jena, Huili Xing
Affiliation(s) ECE, Cornell
Email alh288@cornell.edu, rtc77@cornell.edu, sjb353@cornell.edu, kn383@cornell.edu, grace.xing@cornell.edu, djena@cornell.edu
Primary CNF Tools Used: i-line stepper, e-beam evaporator, AJA sputter, SEM, AFM, Oxford PECVD, Oxford ALD FlexAL, PT770, Oxford 81, glen1000 resist strip, JEOL 6300.

9 Dorsey Poster Info

Atomic Layer Deposition for Membranes, Metamaterials, and Mechanisms

Author(s) Kyle J. Dorsey [1], Tanner G. Pearson [1], Edward Esposito [2], Sierra Russell [4], Baris Bircan [1], Yimo Han [1], Marc Z. Miskin [2,3,5], David A. Muller [1,3], Itai Cohen [2,3], and Paul L. McEuen [2,3]
CNF Project 900-00
Affiliation(s) Cornell University: [1] School of Applied and Engineering Physics, [2] Laboratory of Atomic and Solid State Physics, [3] Kavli Institute for Nanoscale Science; SUNY Polytechnic Institute: [4] Colleges of Nanoscale Science and Engineering; University of Pennsylvania: [5] Department of Electrical and Systems Engineering
Principal Investigator Paul McEuen
Email kjd96@cornell.edu
Primary CNF Tools Used: AS200 stepper, Oxford ALD, Arradiance ALD, AJA Sputter, Oxford 80s, PT770, CVC Evaporators, Zeiss SEMs, Veeco AFM, P7 profilometer, Filmmetrics F40

10 Chen Huiyao Poster Info

Engineering electron-phonon coupling of quantum defects to a bulk acoustic resonator

CNF Project # 212612
Author(s) Huiyao Chen, Evan R. MacQuarrie, Noah F. Opondo, Boyang Jiang, Sunil A. Bhave and Gregory D. Fuchs
Principal Investigator Gregory D. Fuchs
Affiliation(s) School of applied and engineering physics, Cornell University
Email hc846@cornell.edu, gdf9@cornell.edu
Primary CNF Tools Used: g-line stepper, AJA sputtering deposition system, evaporator, PT770 plasma etcher, SEM, AFM, Zygo profilometer.

11 Abdelmejeed Poster Info

A CMOS Compatible GHZ Ultrasonic Pulse Phase Shift Based Temperature Sensor

CNF Project # 112103
Author(s) Mamdouh Abdelmejeed, Justin C. Kuo, Amit Lal
Principal Investigator Amit Lal
Affiliation(s) Electrical and Computer Engineering, Cornell University
Email moa35@cornell.edu, jck226@cornell.edu, amit.lal@cornell.edu

12 Miles Poster Info

Nanofabrication for Astronomical Reflection Gratings

CNF Project # #269218
Author(s) Drew M. Miles, Randall L. McEntaffer, and Fabien Grisé
Principal Investigator Randall L. McEntaffer
Affiliation(s) Penn State University
Email dmiles@psu.edu, rlm90@psu.edu, fug39@psu.edu
Primary CNF Tools Used: AJA Ion Mill, Zeiss Supra/Ultra SEMs, LPCVD Nitride

13 Davaji Poster Info

Shock-Insensitive Acoustic Gyroscope

CNF Project # 112203
Author(s) Benyamin Davaji, Visarute Pinrod, Amit Lal
Principal Investigator Amit Lal
Affiliation(s) SonicMEMS Laboratory, ECE Department, Cornell University.
Email bendavaji@cornell.edu, vp239@cornell.edu, amit.lal@cornell.edu

14 Ravi Poster Info

Localized microfluidic actuation and mixing using planar Fresnel type GHz ultrasonic transducer

CNF Project # 112103
Author(s) Adarsh Ravi, Justin Kuo, Amit Lal
Principal Investigator Prof. Amit Lal
Affiliation(s) SonicMEMS Laboratory, ECE department, Cornell University
Email ar2256@cornell.edu, jck226@cornell.edu , amit.lal@cornell.edu
Primary CNF Tools Used: Heidelberg Mask Writer – DWL2000, Westbond 7400A Ultrasonic Wire Bonder, ABM Contact Aligner, SU-8 Hotplates, YES Polyimide Bake Oven, Optical Microscopes, CorSolutions Microfluidic Probe Station, Harrick Plasma Generator, High-temperature PDMS Curing Oven, Low-temp PDMS Vacuum Oven, P7 Profilometer

15 Plumridge Poster Info

Measuring RNA dynamics one molecule at a time with SU8 microfluidics

CNF Project # 692-98
Author(s) Alex Plumridge and Lois Pollack
Principal Investigator Lois Pollack
Affiliation(s) Cornell University Applied and Engineering Physics
Email addresses for author(s) ap866@cornell.edu, lp26@cornell.edu
Primary CNF Tools Used: Heidelberg Mask writer, ABM contact aligner, versa laser, zygo optical profilometer

16 Ivy Poster Info

Achieving Large Force and Displacement via Silicon Brush Drive Actuator

CNF Project # 126204
Author(s) Landon Ivy, Dr. Amit Lal, Dr. Robert Shepherd, Dr. Benyamin Davaji, Di Ni, Ronald Heisser, & Kaiyang Wang
Principal Investigator Dr. Amit Lal
Affiliation(s) ECE Cornell University
Email lsi8@cornell.edu, amit.lal@cornell.edu, bendavaji@cornell.edu, rfpshepherd@gmail.com, dn273@cornell.edu, rh578@cornell.edu, kw545@cornell.edu
Primary CNF Tools Used: Plasma-Therm Versaline, Oxford 81, Anatech, Furnace, Oxford 100, Oxford PECVD, MA6, & Heidelberg mask writer

17 Bader Poster Info

Gan-on-AlN for Integrated Wide-bandgap Electronics

CNF Project # 280019
Author(s) Samuel James Bader, Reet Chaudhuri, Austin Hickman, Kazuki Nomoto, Huili Grace Xing, Debdeep Jena
Principal Investigator Debdeep Jena
Affiliation(s) Sam AEP, Reet ECE, Austin ECE, Kazuki ECE, Grace ECE / MSE, Debdeep ECE/MSE
Email sjb353@cornell.edu, djena@cornell.edu
Primary CNF Tools Used: GCA Autostep, PT770, Evaporator

18 Li (Wenshen) Poster Info

Barrier Height Stability & Reverse Leakage Mechanisms in Ni/Ga2O3 (001) Schottky Barrier Diodes

CNF Project # 280019
Author(s) Wenshen Li, Kazuki Nomoto, Zongyang Hu, Debdeep Jena, and Huili Grace Xing
Principal Investigator Huili Grace Xing
Affiliation(s) School of Electrical and Computer Engineering, Department of Material Science and Engineering and Kavli Institute at Cornell for Nanoscale Science
Email wl552@cornell.edu (Wenshen Li), grace.xing@cornell.edu (PI)

19 Tao Poster Info

Switching two-dimensional magnets by spin fluctuation

CNF project number 263318
Authors Chenhao Jin1, Zui Tao2, Kaifei Kang2, Kenji Watanabe3, Takashi Taniguchi3, Kin Fai Mak1,2,4, Jie Shan1,2,4
Principal Investigator(s) Kin Fai Mak, Jie Shan
Affiliations: 1 Kavli Institute at Cornell for Nanoscale Science, Ithaca, NY 14853, USA; 2 School of Applied and Engineering Physics, Cornell University, Ithaca, NY 14853, USA; 3 National Institute for Materials Science, 1-1 Namiki, Tsukuba, 305-0044, Japan; 4 Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, NY 14853, USA.
Email zt227@cornell.edu, jinchenhao@cornell.edu, kk726@conrell.edu, WATANABE.Kenji.AML@nims.go.jp, TANIGUCHI.Takashi@nims.go.jp, km627@cornell.edu, jie.shan@cornell.edu
Primary CNF Tools Used: Heidelberg Mask Writer DWL2000, Autostep i-line Stepper, SC4500 Odd-Hour Evaporator

20 Zhu Poster Info

Ultrafast Energy-efficient Spin-torque Magnetic Random Access Memories

CNF Project 244416
Author(s) Lijun Zhu, Shengjie Shi, Daniel C. Ralph, Robert A Buhrman
Principal Investigator Robert A Buhrman
Affiliation(s) Applied and Engineering Physics, Cornell University
Email addresses lz442@cornell.edu, rab8@cornell.edu
Primary CNF Tools Used: JEOL 6300. ASML, Veeco AFM, AJA sputtering

21 Käfer Poster Info

Preparation of polymer-grafted nanoparticles for designing 2D superlattices and arrays

CNF Project # (175709)
Author(s) Dr. Florian Käfer
Principal Investigator Prof. Christopher Kemper Ober
Affiliation(s) Cornell University, Materials Science and Engineering
Email fhk28@cornell.edu; cko3@cornell.edu
Primary CNF Tools Zetasizer and Nanosight

22 Ruyack Poster Info

Ultralow Power NEMS Wakeup Radio Receiver & A Pathway for AI in the Cleanroom

Author(s) Alexander Ruyack, Benyamin Davaji, Landon Ivy, Leanna Pancoast, Nabil Shalabi, Alyosha Molnar and Amit Lal
CNF Project # 126204
CNF Principal Investigator Amit Lal
Affiliation(s) Electrical & Computer Engineering, Cornell University
Email arr68@cornell.edu
Primary CNF Tools Used: ASML 300C DUV Stepper, Zeiss Ultra & Supra SEMs, Oxford 81 & 82 Etchers, Oxford 100 Etcher, Hamatech Hot Piranha, Primaxx Vapor HF Etcher, Plasma-Therm Deep Si Etcher, Dicing saw – Disco, Wire Bonder, Zygo, Furnaces, ResMap, Nanostrip Bath

23 Sun Poster Info

Electroplating of Sn Film on Nb Substrate for Generating Nb3Sn Thin Films and Post Laser Annealing for Accelerator Applications

CNF Project Number 2279-19
Author list Zeming Sun, Matthias Liepe, Thomas Oseroff, Ryan D. Porter; Tomas Arias, Juliane Scholtz, Nathan Sitaraman; Kevin D. Dobson; Xiaoyu Deng; Aine Connolly, Michael O. Thompson
Principal Investigator Matthias Liepe
Affiliation(s) Cornell Laboratory for Accelerator-based Sciences and Education, Cornell University; Department of Physics, Cornell University; Institute of Energy Conversion, University of Delaware; Chemical Engineering, University of Virginia; Materials Science and Engineering, Cornell University
Emai zs253@cornell.edu, mul2@cornell.edu
Primary CNF Tools Used: Oxford FlexAL atomic layer deposition system, Arradiance Gemstar-6 atomic layer deposition system, Woollam spectroscopic ellipsometer, Zygo optical profilometer, P10 profilometer.

24 Abe Cothard Zou Poster Info

Development of Metamaterial Filters for Astronomical Instruments

CNF Project # 245816
Author(s) Bugao Zou, Nicholas Cothard, Mahiro Abe, Gordon Stacey, Thomas Nikola, Michael Niemack
Principal Investigator Gordon Stacey
Affiliation(s) Cornell Department of Applied Physics, Cornell Department of Applied Physics, Cornell Department of Physics, Cornell Department of Astronomy, Cornell Department of Astronomy, Cornell Department of Physics
Email bz332@cornell.edu, nc467@cornell.edu, ma797@cornell.edu, stacey@cornell.edu, tn46@cornell.edu, niemack@cornell.edu
Primary CNF Tools Used: ABM Contact Aligner, Oxford Plasma Enhanced Chemical Vapor Deposition, Anatech Resist Strip, Oxford 82 Etcher, Hamatech-Steag Wafer Processors, Manual Resist Spinners, Resist Hot Strip Bath, Heidelberg Mask Writer DWL2000, Plasma-Therm Deep Silicon Etcher, Zygo Optical Profilometer, Zeiss Supra/Ultra SEM

25 Gupta Poster Info

Investigation into the InGaO3(ZnO)m homologous series via optical characterization

CNF Project # 150-82
Author(s) Vidit Gupta, Katherine Quinn, Aine Connolly, Duncan Sutherland, Maxamillian Amsler
Principal Investigator Michael Thompson
Affiliation(s) Department of Materials Science and Engineering, Cornell University
Email vg295@cornell.edu, mot1@cornell.edu
Primary CNF Tools Used: Photolithography, Thermal Evaporator

26 Ni Di Poster Info

MEMS RF Accelerators for Nuclear Energy and Advanced Manufacturing

CNF Project # 112103
Author(s) D. Ni, S. Sinha, A. Persaud, P. A. Seidl, Q. Ji, T. Schenkel, K. Afridi, A. Lal
Principal Investigator Amit Lal
Affiliation(s) SonicMEMS Laboratory, Electrical and computer engineering department, Cornell University
Email dn273@cornell.edu, amit.lal@cornell.edu
Primary CNF Tools Used: MARK 50 Evaporation and Cu Electroplating

27 Harper Poster Info

Mechanical Stress Promotes Bacterial Efflux Pump Disassembly

CNF Project # 197010
Author(s) Christine Harper, Melanie Roberts, Lauren Genova, Wenyao Zhang, Yu-Chern Wong, Peng Chen, and Christopher Hernandez
Principal Investigator Christopher Hernandez
Affiliation(s) Meinig School of Biomedical Engineering and Sibley School of Mechanical and Aerospace Engineering, Department of Chemistry, Cornell University
Email ceh272@cornell.edu, mfr75@cornell.edu, lag282@cornell.edu, wz338@cornell.edu, yw698@cornell.edu, pc252@cornell.edu,and cjh275@cornell.edu

28 Ren Poster Info

Transport Study of High Mobility 2DEG in AlGaN/GaN Heterostructure grown by plasma-assisted MBE

CNF Project 2800-19
Authors Yuxing Ren, Yongjin Cho, Reet Chaudhuri, Zexuan Zhang
Principal Investigator Huili Grace Xing
Affiliation(s) Department of Materials Science and Engineering
Email yr237@cornell.edu, grace.xing@cornell.edu
Primary CNF Tools Used: CVD

29 Connolly Poster Info

Autonomous Experimental Phase Analysis of Oxide Systems Demonstrated via Optical Imaging and Spectroscopy

CNF Project # 150-82
Author(s) Aine Connolly, Duncan Sutherland, Max Amsler, Sebastian Ament, Michael O. Thompson, Bruce van Dover, Carla Gomes.
Principal Investigator Michael O. Thompson
Affiliation(s) Dept. of Materials Science and Engineering, Cornell
Email ac2733@cornell.edu, mot1@cornell.edu
Primary CNF Tools Used: Oxidation furnaces, photolithography room, ABM contact aligner, thermal evaporator

30 Sutherland Poster Info

Analyzing Microsctructure and Film Integrity in High-Dimensional Processing Spaces

CNF Project # 1400-05
Author(s) Duncan Sutherland, Aine Connolly, Maximilian Amsler, Sebastian Ament, Brendan Rapazzo, Mrinal Thomas, Carla Gomes, Michael O. Thompson
Principal Investigator R. Bruce van Dover
Affiliation(s) Materials Science and Engineering, Computer Science
Email drs378@cornell.edu, vandover@cornell.edu

31 Sagar Poster Info

Coupling a Superconducting Qubit to a Left-Handed Metamaterial Resonator

CNF Project # 173508

Author(s) Indrajeet Sagar, H. Wang, M.D. Hutchings, M.D. LaHaye, B.L.T Plourde, B.G. Taketani, F.K. Wilhelm
Principal Investigator B.L.T Plourde
Affiliation(s) Department of Physics, Syracuse University, Syracuse, NY 13244-1130; Theoretical Physics, Saarland University, Campus, 66123 Saarbrücken, Germany
Email indraje@syr.edu, hwang42@syr.edu, mattai1986@gmail.com, mlahaye@syr.edu, bplourde@syr.edu, btaketani@gmail.com, fkwilhelm@gmail.com

32 Gray Poster Info

Magneto-thermal microscopy a new way to image antiferromagnets

CNF Project Number 2091-11

Authors Isaiah Gray (presenting), Gregory M. Stiehl, Takahiro Moriyama, Nikhil Sivadas, Antonio B. Mei, John T. Heron, Ryan Need, Brian J. Kirby, David H. Low, Katja C. Nowack, Ramamoorthy Ramesh, Darrell G. Schlom, Teruo Ono, Daniel C. Ralph, and Gregory D. Fuchs
Principal investigator Gregory D. Fuchs
Affiliations School of Applied and Engineering Physics, Cornell University, Ithaca, NY
Email ig246@cornell.edu, gdf9@cornell.edu

Primary CNF Tools Used: GCA 5x stepper, Heidelberg DWL2000 mask writer, AJA ion mill, AJA sputter system

33 Balazs Poster Info

Inkjet printing single crystal colloidal quantum dot solids

CNF # 164508

Authors Daniel Balazs, Deniz Erkan, Michelle Quien, Tobias Hanrath
Principal investigator Tobias Hanrath
Affiliation School of Chemical and Biomolecular Engineering, Cornell University
Email daniel.balazs@cornell.edu and tobias.hanrath@cornell.edu

Tools Photolithography tools, Dimatix materials printer

34 Dey Huang Luo Poster Info

Microfluidics for modeling interstitial flows in breast tumor cell invasion

CNF Project # 206811

Author(s) Yu Ling Huang, Sumit Dey, Tao Luo, Yujie Ma, Cindy Wu, Carina Shiau, Jeffrey E. Segall, and Mingming Wu
Principal Investigator Mingming Wu
Affiliation(s) Department of Biological and Environmental Engineering
Email yh486@cornell.edu; skd89@cornell.edu; tl565@cornell.edu; mw272@cornell.edu

Primary CNF Tools Used: Karl Suss MA/BA 6 aligner, SUSS Microtech, Unaxis 770 Deep Silicon Etcher, Anatech Resist Strip, Molecular Vapor Deposition, Applied Microstructures

35 Guo Poster Info

Developing a single spin magnetic microscope to probe antiferromagnets at the nanoscale

CNF Project # (2091-11)

Author(s) Qiaochu (Nicole) Guo, Isaiah Gray, Katja C. Nowack, Gregory D. Fuchs
Principal Investigator Katja C. Nowack, Gregory D. Fuchs
Affiliation(s) School of Applied and Engineering Physics, Department of Physics
Email qg58@cornell.edu, ig246@cornell.edu, kcn34@cornell.edu, gdf9@cornell.edu

36 Park (Albert) Poster Info

Study of Magnetic Skyrmion using Lorentz Transmission Electron Microscopy

CNF Project # 209111
Author(s) Albert M. Park, Zhen Chen, Varshith Kandula, Alan Chen, David A. Muller, Gregory D. Fuchs
Principal Investigator Gregory D. Fuchs
Affiliation(s) Applied and Engineering Physics, Cornell University
Email amp356@cornell.edu (presenter) and gdf9@cornell.edu (PI)
Primary CNF Tools Used: GCA 5X stepper, Photolithography preparation tools

37 Li (Ruofun) Poster Info

Non-local spin transport in complex oxide thin films

CNF Project # 598-96
Author(s) Ruofan Li, Tianxiang Nan
Principal Investigator Daniel Ralph
Affiliation(s) Physics, Cornell University
Email rl643@cornell.edu, tn272@cornell.edu dcr14@cornell.edu
Primary CNF Tools Used: JEOL JBX-6300FS 100 kV Electron Beam Lithography System, Scanning Electron Microscope, Veeco Icon Atomic Force Microscope

38 Miller Poster Info

Epitaxial AlN BAW Resonators for 5G and Beyond

CNF Project # 280219
Author(s) Jeffrey Miller, John Wright, Huili (Grace) Xing, Debdeep Jena
Principal Investigator Debdeep Jena
Affiliation(s) Electrical and Computer Engineering, Material Science and Engineering, Kavli Institute at Cornell
Email jpm433@cornell.edu, jgw92@cornell.edu, djena@cornell.edu, grace.xing@cornell.edu
Primary CNF Tools Used: PT 770, AJA Sputter Tool, ABM, Ebeam Evaporator

39 Ballard Poster Info

Developing a Quantum-Classical Interface for Coherent Control of Superconducting Qubits

CNF Project # 173508
Authors Andrew Ballard, Kenneth Dodge, Vito Iaia, JJ Nelson, Caleb Howington, Jaseung Ku, Chuan-Hong Liu, Edward Leonard, Matthew Beck, Alex Kirichenko, Daniel Yohannes, Igor Vernik, Jason Walter, Oleksandr Chernyashevskyy, Oleg Mukhanov, Robert McDermott, Britton Plourde
Principal Investigator Britton Plourde
Affiliation(s) Physics Syracuse University
Email alballar@syr.edu
Primary CNF Tools Used: ASML, PT770/740 etcher, JEOL 9500

40 Xie Poster Info

Fabrication and measurements of arrays of constriction-based spin-Hall nano-oscillators

CNF Project # 209111
Author(s) Yanyou Xie
Principal Investigator Gregory D. Fuchs
Affiliation(s) Applied & Engineering Physics, Cornell University
Email yx322@cornell.edu, gdf9@cornell.edu
Primary CNF Tools Used: JEOL9500, MA6 Contact Aligner

41 Mathur Poster Info

Rabi Oscillations from Quantum Emitters in Hexagonal Boron Nitride

CNF Project # 216612
Author(s) Nikhil Mathur, Kumarasiri Konthasinghe, Chitraleema Chakraborty, Liangyu Qiu, Arunabh Mukherjee, Nick Vamivakas, Gregory D. Fuchs
Principal Investigator Gregory Fuchs
Affiliation(s) Applied and Engineering Physics, Cornell
Email nm648@cornell.edu, gdf9@cornell.edu
Primary CNF Tools Used: ASML DUV Stepper, Oxford 81 etcher, SC4500 E-gun Evaporator

42 Boucher / Sun Poster Info

A Thin Film Transfer Sample Preparation Technique for Single-Electron Magnetic Resonance Imaging

CNF Project # 86300
Authors Michael Boucher and Peter Sun (both presenting)
Principal Investigator John Marohn
Affiliation Cornell Department of Chemistry and Chemical Biology
Email mcb344@cornell.edu, hs859@cornell.edu, jam99@cornell.edu
Primary CNF Tools Used: SC 4500 Combination Thermal/E-gun Evaporation System, JEOL JBX-6300FS electron-beam lithography system

43 Huang (Yuming Robin) Poster Info

Nanometer-scale Area-Selective Formation of Polymer Brushes

CNF Project # 1757-09
Author(s) Yuming Huang(2), Hai Quang Tran(1,2)
Principal Investigator Christopher Kemper Ober (2)
Affiliation(s) 1. Chemical and Biomolecular Engineering, 2. Department of Materials Science and Engineering; Cornell University
Email yh839@cornell.edu, hqt2@cornell.edu, cko3@cornell.edu

44 Szoka Poster Info

Neural Probes for Microcoil Magnetic Stimulation with CMOS Technology Integration

CNF Project # 2658-18
Authors Edward Szoka, Sunwoo Lee, Jae-Ik Lee, Alejandro Cortese, Shelley Fried, Alyosha Molnar
Principal Investigator Alyosha Molnar
Affiliations Cornell University Department of Electrical and Computer Engineering, Cornell University Department of Physics, Massachusetts General Hospital Department of Neurosurgery Harvard Medical School
Email ecs227@cornell.edu, sl933@cornell.edu, JLEE275@mgh.harvard.edu, ajc383@cornell.edu, Fried.Shelley@mgh.harvard.edu, molnar@ece.cornell.edu
Primary CNF Tools Used: Oxford ALD FlexAL, AJA Sputter Deposition, ABM Contact Aligner, Unaxis 770, PT770 Etcher

45 Karimeddiny Poster Info

Hall-STFMR Devices for Self-Consistent Determination of Spin Pumping Signal

CNF Project # 598-96
Author(s) Saba Karimeddiny, Joseph Mittelstaedt, Robert A. Buhrman, Daniel C. Ralph
Principal Investigator Dan Ralph
Affiliation(s) Physics Dept. Cornell University
Email sk2992@cornell.edu, dcr14@cornell.edu
Primary CNF Tools Used: Photolithography prep, 5x g-line stepper, AJA sputter deposition, Heidelberg DWL2000 mask writer

46 Hwang Poster Info

Planar GHz Ultrasonic Lens for Wafer Scale Fourier Computation

CNF Project # 112103
Authors JuneHo Hwang, Benyamin Davaji, Justin Kuo, Amit Lal
Principal Investigator Professor Amit Lal
Affiliation Cornell ECE
Email jh882@cornell.edu, bendavaji@cornell.edu, jck226@cornell.edu, amit.lal@cornell.edu
Primary CNF Tools Used: ABM contact aligner, ASML, furnace, P7, Unaxis DRIE

47 Fu Poster Info

Evaluation of 2D materials Using Electron Beam vs Helium Beam Lithography

CNF Project # 2451-16
Author(s) Matthew Fu
Principal Investigator Nai-Chang Yeh, and Dr. Matthew Hunt
Affiliation(s) Caltech University/ Kavli Nanoscience Institute
Email mf564@cornell.edu, ncyeh@caltech.edu, matthew.hunt@caltech.edu
Primary CNF Tools Used: Electron beam lithography tool and Helium beam microscope.

48 Otsubo Poster Info

Progress in Metal-Organic Cluster Photoresists for EUV Lithography

CNF Project # 38690
Author(s) Yusuke Otsubo1,2; Kazunori Sakai1,2; Wenyang Pan1; Seok-Heon Jung1; Emmanuel P. Giannelis1; Christopher K. Ober1
Principal Investigator Christopher K. Ober
Affiliation(s) 1 Cornell University; 2 JSR Corporation
Email yo237@cornell.edu; ks2288@cornell.edu; wp222@cornell.edu; sj736@cornell.edu; epg2@cornell.edu; c.ober@cornell.edu
Primary CNF Tools Used: Zeiss Supra scanning electron microscope (SEM), ASML 300C DUV Stepper, ABM Contact Aligner

49 Xu Poster Info

Controlling 2D magnetism by stacking engineering

CNF Project # 269718
Author(s) Yang Xu, Tingxin Li, Nikhil Sivadas, Ariana Ray, Yu-Tsun Shao, Shengwei Jiang, Zefang Wang, Daniel Weber, Kenji Watanabe, Takashi Taniguchi, Joshua Goldberger, Craig J. Fennie, David A. Muller, Kin Fai Mak, and Jie Shan
Principal Investigator Kin Fai Mak, Jie Shan
Affiliation(s) School of Applied and Engineering Physics, Department of Physics, Kavli Institute at Cornell for Nanoscale Science, Cornell University
Email yx542@cornell.edu, km627@cornell.edu, jie.shan@cornell.edu
Primary CNF Tools Used: SC4500 Odd-Hour Evaporator, Stepper

50 Chaudhuri Poster Info

MBE Growth of AlN-based HEMT Structures on 6H-SiC and Si Substrates

CNF Project # 2470-16
Author(s) Reet Chaudhuri, Samuel James Bader, Austin Hickman, Huili Grace Xing, Debdeep Jena
Principal Investigator Debdeep Jena, Huili Xing
Affiliation(s) Electrical Engineering, Cornell
Email rtc77@cornell.edu, djena@cornell.edu, grace.xing@cornell.edu
Primary CNF Tools Used: Veeco AFM, Wet chemisty, Photolith, PT-770 etcher

51 Reynolds Poster Info

Surface Electrochemical Actuators for Swimming Microrobots

CNF Project # 900-00
Author(s) Michael Reynolds 1, Qingkun Liu 1,2, Wei Wang 1, Alejandro Cortese 1, Marc Miskin 1,2,4, Itai Cohen 1, Paul McEuen 1,2
Principal Investigator Paul McEuen
Affiliation(s) 1 Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, NY 14850, USA; 2 Kavli Institute at Cornell for Nanoscale Science, Cornell University, Ithaca, NY 14850, USA; 3 Department of Chemistry and Chemical Biology, Cornell University, Ithaca; 4 Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA 19104, USA
Email mfr74@cornell.edu, plm23@cornell.edu
Primary CNF Tools Used: Arradiance ALD, AJA Sputter Deposition, Oxford 80 etchers, Xactic Xenon Difluoride Etcher, ABM Contact Aligner

52 Liu (Fangchen) Poster Info

Microhabitat Platform to Study Harmful Algal Blooms

CNF Project # 2262-13
Author(s) Fangchen Liu, Nicole D. Wagner, Mohammad Yazdani, Beum Jun Kim, Beth A. Ahner, and Mingming Wu
Principal Investigator Dr. Mingmin Wu
Affiliation(s) Biological and Environmental Engineering, Cornell
Email fl373@cornell.edu mw272@cornell.edu
Primary CNF Tools Used: Heidelberg Mask Writer – DWL2000, ABM Contact Aligner, P10 Profilometer, MVD100

53 Oeschger Poster Info

Microfluidic Chip for Sepsis Diagnosis at the Point of Care

CNF Project # 263618
Author(s) Taylor Oeschger, Ankur Singh, David Erickson
Principal Investigator David Erickson
Affiliation(s) Biomedical Engineering and Mechanical Engineering, Cornell University
Email tmo55@cornell.edu, as2833@cornell.edu, de54@cornell.edu
Primary CNF Tools Used: Unaxis 770 Etcher, Photolithography, PDMS casting station

54 Bircan Poster Info

Self-Folding Micro-Origami with Atomic Layer Deposition Bimorph Actuators

CNF Project # 241616
Author(s) Baris Bircan, Marc Z. Miskin, Robert J. Lang, Kyle J. Dorsey, Paul L. McEuen, Itai Cohen
Principal Investigator Itai Cohen
Department and Institution Applied and Engineering Physics, Cornell University
Email bb625@cornell.edu, itai.cohen@cornell.edu
Primary CNF Tools Used: Oxford ALD FlexAL, SC4500 Evaporator, ABM Contact Aligner, Oxford 81 Etcher, PT770 Etcher, Heidelberg DWL2000 Mask Writer

55 Xiong Poster Info

Thermal Dependence of Al2O3 Passivated RF WSe2 MOSFETs

CNF Project # 250916
Author(s) K. Xiong, L. Li, B. Davis, A. Madjar, N. C. Strandwitz, J. C. M. Hwang, X. Zhang, J. Redwing, A. Göritz, M. Wietstruck, and M. Kaynak
Principal Investigator James C. M. Hwang
Affiliation Electrical Engineering, Lehigh University
Email kux214@lehigh.edu, jh00@lehigh.edu
Primary CNF Tools Used: ABM Contact Aligner, Autostep I-line Stepper, PT720-740 Etcher, SC4500 Odd-Hour Evaporator, and P10 Profilometer

56 Windsor Poster Info

Advancements in the Design and Application Microfluidic Devices to Study Cell Migration in Confined Spaces

CNF Project # 206511
Author(s) Aaron Windsor, Alex McGregor, Pragya Singh, Jeremiah Hsia
Principal Investigator Jan Lammerding
Affiliation(s) BME/CNF
Email ajw49@cornell.edu, jan.lammerding@cornell.edu
Primary CNF Tools Used: Uniaxis Plasma-Therm 770 DRIE, Anatech Resist strip etcher, Trion Minilock III ICP Etcher, ABM and MA6 contact aligners, Molecular Vapor Deposition Tool

57 Bosch Poster Info

Melissa Bosch
mb2583@cornell.edu
Applied & Engineering Physics, Cornell University
Project Number 2472-16
Principal Investigator Gennady Shvets

58 Jiang Poster Info

Shengwei Jiang
sj538@cornell.edu
LASSP, Clarkson University
CNF Project Number 263318
Principal Investigator(s) Jie Shan & Kin Fai Mak

59 Kang Poster Info

Kaifei Kang
kk726@cornell.edu
Applied & Engineering Physics, Cornell University
CNF Project 263318
Principal Investigator Jie Shan

60 Li (Lizhong) Poster Info

WSe2/WS2 moiré superlattices a new Hubbard model simulator

CNF Project # 263318
Author(s) Yanhao Tang , Lizhong Li , Tingxin Li, Yang Xu, Jie Shan, Kin Fai Mak
Principal Investigator Jie Shan, Kin Fai Mak
Affiliation(s) School of Applied and Engineering Physics, Cornell University, Ithaca, NY, USA
Email jie.shan@cornell.edu; kinfai.mak@cornell.edu
Primary CNF Tools Used: Autostep i-line stepper, SC4500 Odd/Even-Hour Evaporator, Zeiss Supra SEM