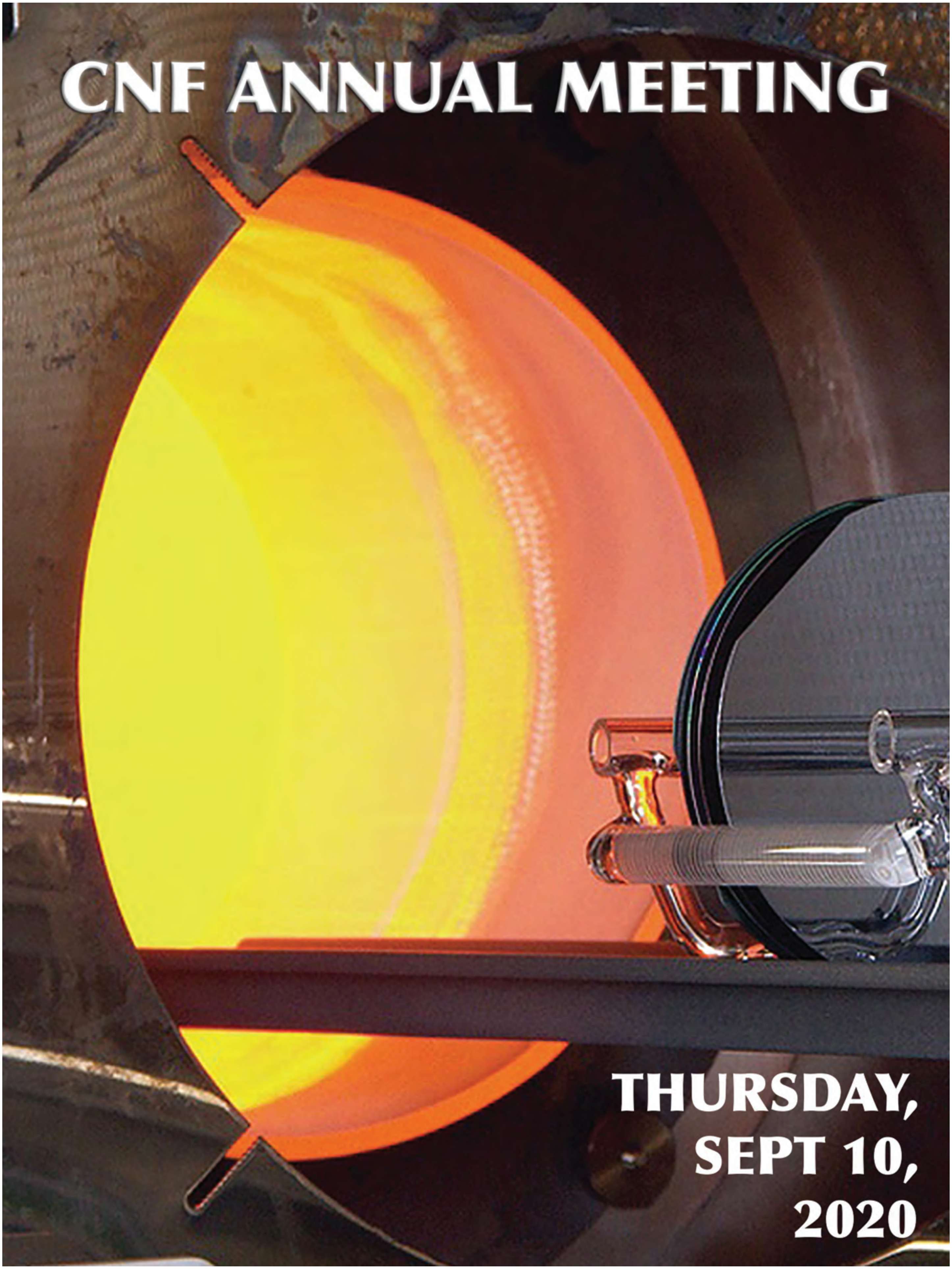
CNF ANNUAL MEETING



THURSDAY, SEPT 10, 2020

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:: 2020 CNF Annual Meeting Schedule ::

Thursday, September 10, 2020

MORNING SESSION

8:30-8:55A; Welcome with CNF Directors; … ..page 5

Christopher Ober, CNF Director
Ron Olson, CNF Director of Operations
Claudia Fischbach-Teschl, CNF Associate Director

8:55-9:00; (set up for next speaker)

9:00-9:30; Keynote Speaker; … ..page 6

Dr. Lidija Sekaric, National Business Director, Distributed Energy, Siemens

"The Accelerating Energy Transition"

9:30-9:45; Break and set up for next speaker

9:45-10:00; Ms. Melissa Bosch, Applied and Engineering Physics, Cornell . … … … … … … ..page 7
"Tunable Semiconductor Metasurfaces for Polarization State Synthesizers and Active Lensing"

10:00-10:05; (set up for next speaker)

10:05-10:20; Alejandro Cortese, ECE College of Engineering, Cornell. … … … … … … … … ..page 8
"CFAB: Heterogeneous Integration for Microscopic Sensors and Robots"

10:20-10:25; (set up for next speaker)

10:25-10:40; Mr. Tao Luo, Biological and Environmental Engineering, Cornell .. … … … … … ..page 9
"Engineering Micrometer Scale Robotic Swimmers for Biomedical Applications"

10:40-10:45; (set up for next speaker)

10:45-11:15; Keynote Speaker; … page 10

Dr. Lawrence Goldberg, Senior Engineering Advisor, National Science Foundation

"National Nanotechnology Coordinated Infrastructure:
Critical Nanotechnology Facilities for Emerging NSF and US Research Priorities"

11:15-11:30; Break and set up for next speaker

11:30-11:45; Mr. Edward Szoka, Electrical and Computer Engineering, Cornell. … … … … page 11
"Designing Neural Probes Utilizing Micro-coil Magnetic Stimulation with
CMOS Technology Integration for Spatially Programmable Neurostimulation"

11:45-11:50; (set up for next speaker)

11:50-12:05P; Ms. Emma Long, Materials Science and Engineering, Cornell .. … … … … … page 12
"β-Ga_2O_3 Lateral FinFETs Fabrication and Preliminary Devices Performance"

12:05-12:10P; (set up for next speaker)

12:10-12:25; Ms. Maya Martirossyan, Materials Science and Engineering, Cornell … … … page 13
"Fabrication and Self-Assembly — Growing Crystal Structures"

12:25-12:30; (set up for next speaker)

12:30-1:00; Keynote Speaker; . … page 14

Dr. Nancy Stoffel, Horizontal Leader-Flexible Hybrid Electronics, GE Global Research

"Flexible Hybrid Electronics for the Digital Industrial World"

:: Poster Session & Corporate Showcase ::

(Poster information begins on page 15)

2:00-3:30 p.m.
Virtual Poster Session & Corporate Showcase

3:30-3:45 p.m.
User Presentation & Poster Awards,
and CNF Whetten Memorial Award

3:50-4:20 p.m.
Optional Virtual Cleanroom Tour

:: Attendees List begins on page 19 ::

Christopher Ober is the Francis Bard Professor of Materials Engineering, and the Lester B. Knight Director of the Cornell NanoScale Facility. (director@cnf.cornell.edu)

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 and 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 is the CNF Director of Operations. (olson@cnf.cornell.edu)

Ron 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.

Claudia Fischbach-Teschl is the Stanley Bryer 1946 Professor of Biomedical Engineering at Cornell, and CNF Associate Director. (cf99@cornell.edu)

Claudia is the Director of Cornell's Physical Sciences Oncology Center on the Physics of Cancer Metabolism. She received her Ph.D. in Pharmaceutical Technology from the University of Regensburg, Germany and holds an M.S. in Pharmacy from the Ludwigs-Maximilians-University, Munich, Germany. She conducted her postdoctoral work at Harvard University in the Division of Engineering and Applied Sciences and joined the faculty of Cornell in 2007. Dr. Fischbach-Teschl's lab applies biomedical engineering strategies to study cancer with the ultimate goal of identifying new mechanisms that may ultimately help to prevent and treat this disease. She serves on the NIH Tumor Microenvironment Study Section and is an editorial board member of various journals including the new ACS journal Biomaterials Science and Engineering.

The Accelerating Energy Transition

Dr. Lidija Sekaric

Department and Institution: Distributed Energy Systems, Siemens

Contact: lidija.sekaric@siemens.com

Website: https://new.siemens.com/global/en/products/energy/topics/distributed-energy-systems.html

Climate change poses one of the greatest challenges that touches upon ecological, economic, political, and many other facets of human activity. At the same time, it brings unprecedented opportunities for the reinvention of energy systems, innovation in materials and devices, new market structures, and creation of new sectors of economy. Not in small part, the energy transition is driven by technological innovation and invention, resulting in cost and performance trends that have already enabled renewable energy to become the default choice for new sources of electricity generation. You will hear about some of the science and technology work that have enabled that success, and about further potential opportunities for solving the remaining challenges necessary to transition to carbon-free energy systems.

In her role as National Business Director, Lidija sets the strategic direction for Siemens business units on the topic of Distributed Energy Systems, with focus on on-site energy generation, energy storage, and advanced control systems, including microgrids and virtual power plants. She leads market approaches to customer segments, policy development, and strategic technology investments.

Lidija has over 15 years of strategic experience in energy and semiconductor industry, and federal government. Prior to joining Siemens she served in a variety of executive and advisory roles at the U.S. Department of Energy (DOE) where she managed a portfolio across multiple applied energy programs and supported and oversaw a number of national lab programs. Her experience at DOE includes serving as the Director of the DOE SunShot Initiative where she led the near and long-term US government solar program strategy. Lidija has served at the executive committee level for several organizations, including the International Energy Agency (IEA) and currently serves on advisory boards of research institutes and non-profit organizations.

Lidija holds a Ph.D. Applied Physics from Cornell University and has been granted 30 U.S. patents.

Tunable Semiconductor Metasurfaces for Polarization State Synthesizers and Active Lensing

Authors: Melissa Bosch, Maxim Shcherbakov, Steven Huang, Zhiyuan Fan, Gennady Shvets

CNF Project Number: 2472-16

CNF Principal Investigator: Gennady Shvets

Department and Institution: Applied and Engineering Physics, Cornell University

Contact Email: mb2583@cornell.edu, gs656@cornell.edu

Primary CNF Tools Used: JEOL 9500, Zeiss Ultra SEM, Oxford Cobra ICP, Oxford PECVD

2019-2020 CNF Research Accomplishments: Pages 104-105

Optical metasurfaces, planar arrays of subwavelength nano-resonators, have emerged as an ultrathin and scalable alternative to conventional free-space optical elements. In particular, semiconductor resonators, such as germanium and silicon, can generate arbitrary spatial phase profiles with low ohmic losses, leading to high-performance waveplates, beam deflectors, and lenses with subwavelength-thickness [1]. However, most metasurfaces have fixed properties post-fabrication. In this contribution, we report on the design and fabrication of time-varying semiconductor metasurfaces, tunable via temperature and electric field, and suitable for various applications where active light modulation is required. In one application, a platform consisting of nematic liquid crystals (LCs) infiltrated into a resonant silicon metasurface is used to facilitate a rapidly dynamic-focus lens. Owing to the electro-optical response of the LCs, the local optical phase profile of the metalens is modified, thereby shifting the focal spot position. Furthermore, we utilize the high thermo-optic coefficient of germanium (Ge) to demonstrate resonant Ge-based metalenses and polarization state generators which can be controlled by heat. These implementations are accomplished through the design of anisotropic resonant Ge-metasurfaces which support high-Q collective resonances. The central frequency of the resonant modes can be shifted by nearly their bandwidth within a 100°C window, resulting in considerable modulations to the transmission and phase of the scattered light [2]. Our findings open new avenues for tunable ultrathin photonic devices.

References:

[1] Soref, R.. "Mid-infrared photonics in silicon and germanium." Nature photonics 4.8 (2010): 495.

[2] Bosch, M., et al. "Polarization states synthesizer based on a thermo-optic dielectric metasurface." Journal of Applied Physics 126.7 (2019): 073102.

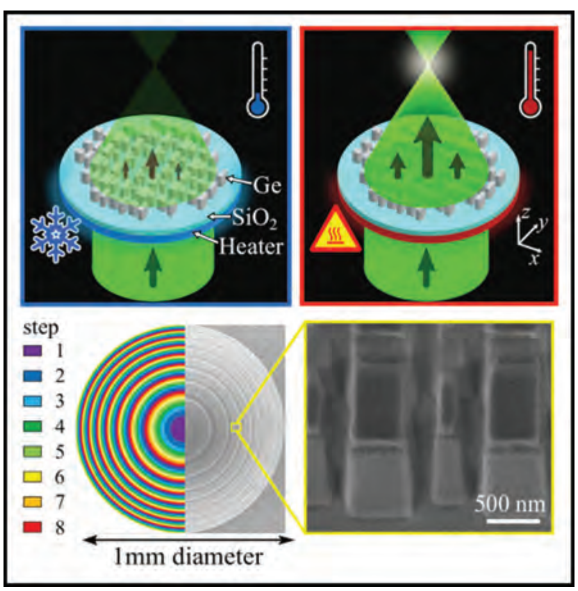

Figure 1: Top: Thermo-optic metalens concept: incident collimated light is focused to a spot with temperature-tunable intensity after transmission through the metalens. Bottom Left: Scanning electron microscope (SEM) of the fabricated spherical metalens. The left half of the lens is color-coded according to its eight phase steps; Bottom Right: SEM of the sixth metalens phase step

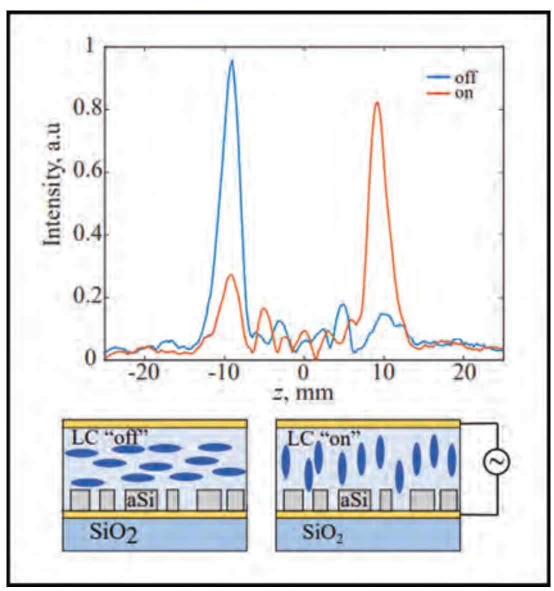

Figure 2: Bottom: Schematic of LC aSi metalens design; Top: Intensity of light transmitted through the aSi metalens, plotted along the optical axis of the lens. The lens acts as a converging lens with +8mm focus in the absence of an external electric field (solid blue line) and acts as a diverging lens with a -8mm focus in the presence of an external electric field (solid red line).

CFAB: Heterogeneous Integration for Microscopic Sensors and Robots

Authors: Alejandro Cortese, Michael Reynolds, Conrad Smart, Samantha Norris, Yanxin Ji, Sunwoo Lee, Ed Szoka, Tianyu Wang, Chris Xu, Marc Miskin, Itai Cohen, Paul McEuen, and Alyosha Molnar

CNF Project Number: 900-00

CNF Principal Investigators: Itai Cohen, Paul McEuen, and Alyosha Molnar

Department and Institution: Electrical and Computer Engineering, Cornell University

Contact Email: ajc383@cornell.edu

Primary CNF Tools Used: ABM Contact Aligner, AJA Orion Sputtering Systems, CVC 4500 Electron Beam Evaporator, Arradiance ALD, Oxford ALD FlexAL, Oxford PECVD, Oxford 100 ICP, Oxford 80s, Oxford Cobra, Plasma Therm Dual Chamber 770, and Xactix XeF2

2019-2020 CNF Research Accomplishments: Pages 46-47, 92-93

Recently, our team of collaborators at Cornell University has been developing a variety of microscopic standalone electronic devices that use light for power and communication. These devices range from optical wireless integrated circuits (OWiCs) made to sense temperature [1], to neural-recording MOTEs [2] and even walking microrobots [3]. In this talk, I'll present our efforts to further expand the capabilities of these microscopic sensors and robots. Specifically, we are developing a new platform that heterogeneously integrates foundry-produced 180 nm CMOS electronics with 1) optical input/output and 2) surface electrochemical actuators. Using this platform, we are developing autonomous microscopic robots that can be powered by sunlight, ~ 100 micron optical 64-bit ID tags, and more.

References:

[1] Cortese, A. J., et al. Microscopic sensors using optical wireless integrated circuits. PNAS (2020)

[2] Lee, S. et al. A 250 µm x 57 µm microscale opto-electronically transduced electrodes (MOTEs) for neural recording. IEEE Trans. Biomed. Circuits Syst. (2018).

[3] Miskin, M. Z. et al. Electronically integrated, mass-manufactured, microscopic robots. Nature (2020).

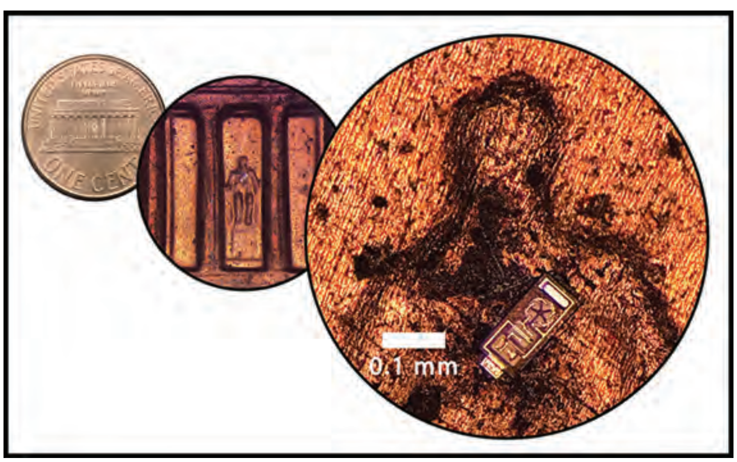

Figure 1: OWiC on penny.

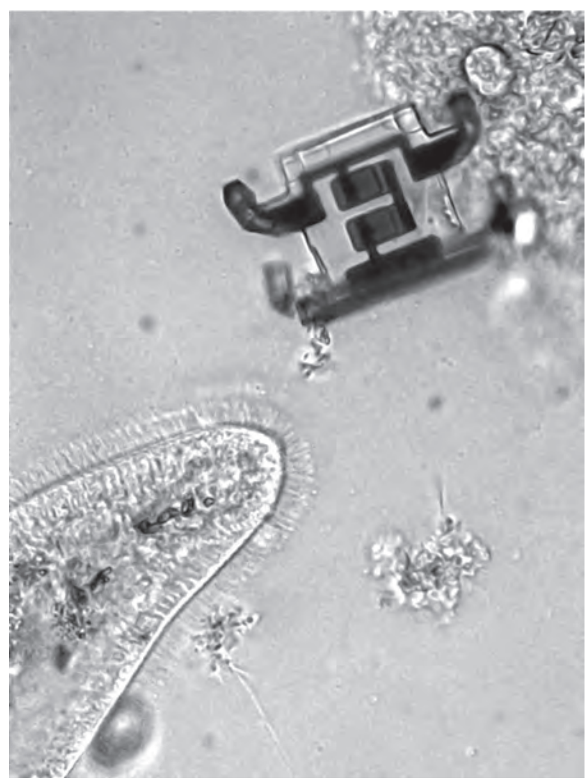

Figure 2: Microscopic robot.

Engineering Micrometer Scale Robotic Swimmers for Biomedical Applications

Authors: Tao Luo and Mingming Wu

CNF Project Number: 2068-11

CNF Principal Investigator: Mingming Wu

Department and Institution: Biological and Environmental Engineering, Cornell University

Contact Email: tl565@cornell.edu, mw272@cornell.edu

Primary CNF Tools Used: Nanoscribe GT2, Scanning Electron Microscope (SEM)

In nature, cells such as immune cells can navigate efficiently to where the infection takes place, and kill the pathogens on site. Here, we aim to engineer micrometer size swimmers that can be steered towards a targeted location for potential biomedical applications including noninvasive biosensing and targeted drug delivery. In this talk, I will present micrometer size swimmers that were created using the Nanoscribe at CNF, that can be controlled remotely by ultrasound wave in megahertz range. We note that megahertz ultrasound has been approved to be safe to operate in clinical setting. The microswimmer contains two partially covered microbubbles trapped inside the body of the swimmer, where microbubbles can be excited remotely by the ultrasound. The streaming flow generated by the oscillating bubbles is used to propel and steer the swimmer in the fluid environment. We show that the direction and speed of the swimmer can be controlled accurately by the amplitude and frequency of the ultrasound wave.

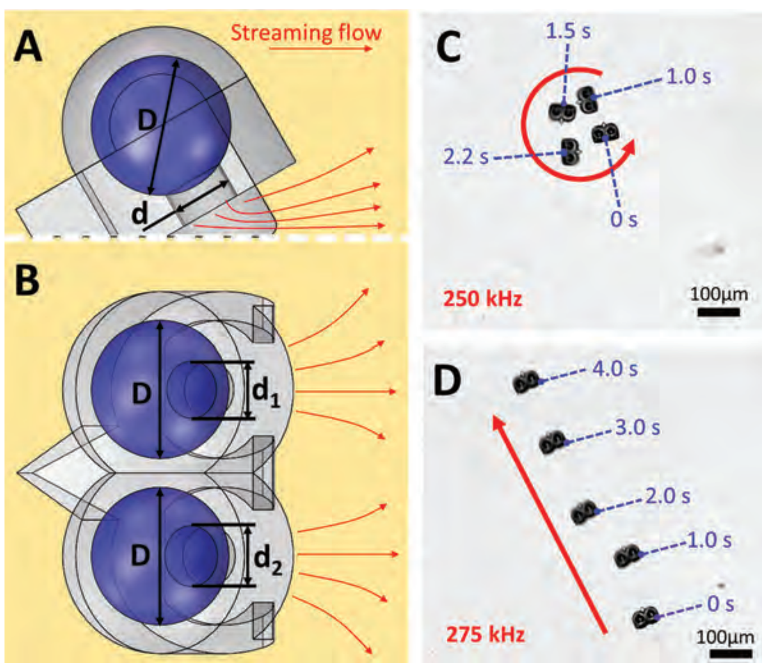

Figure 1: Design and locomotion of the swimmer. (A) Side view of the swimmer design. (B) Top view of the swimmer design. (C) Rotation of a swimmer. (D) Unidirectional movement of a swimmer.

National Nanotechnology Coordinated Infrastructure: Critical Nanotechnology Facilities for Emerging NSF and US Research Priorities

Lawrence S. Goldberg

Senior Engineering Advisor
Division of Electrical, Communications and Cyber Systems
National Science Foundation

Contact: lgoldber@nsf.gov

The NSF has a long history of infrastructure investment in national user facilities to advance the field of nanotechnology. New opportunities, consistent with NSF's long-term research agenda, can push forward the frontiers of science and engineering research, and lead to new discoveries and innovations. The CNF since its establishment has played a major role in these endeavors. I will discuss the impact that NNCI is having, including in attracting a diverse user base and in the breadth of its activities, such as in the quantum realm. I will also discuss opportunities for interdisciplinary research in the ENG directorate and NSF opportunities for establishing mid-scale infrastructure. The National Nanotechnology Initiative (NNI) recently underwent its quadrennial review by the National Academies, and I will discuss some of the outcomes of this extensive study as it pertains to the developing nanotechnology field.

Dr. Goldberg received a B.S. degree in Engineering Physics from Washington University and Ph.D. degree in Solid State Physics from Cornell University. He spent a postdoctoral year at the Physikalisches Institut, Universität Frankfurt, Germany. He was previously with the Naval Research Laboratory as research physicist in the Optical Sciences Division in areas of ultrashort pulse lasers and nonlinear optics. At NSF, he is Senior Engineering Advisor in the Division of Electrical, Communications and Cyber Systems, Directorate for Engineering, serving previously as Division Director. He is lead program officer and guided establishment of the National Nanotechnology Coordinated Infrastructure (NNCI). He led federal agency funding for the National Academies study on Optics and Photonics: Essential Technologies for Our Nation. He is Fellow of the OSA and IEEE.

NSF

National
Nanotechnology
Coordinated
Infrastructure

Designing Neural Probes Utilizing Micro-coil Magnetic Stimulation with CMOS Technology Integration for Spatially Programmable Neurostimulation

Authors: Edward Szoka[1], Sunwoo Lee[1], Jae-Ik Lee[3], Seung Woo Lee[3], Alejandro Cortese[2], Shelley Fried[3,4], Alyosha Molnar[1]

CNF Project Number: 2847-19

CNF Principal Investigator: Alyosha Molnar

Departments and Institutions: 1. Electrical and Computer Engineering, Cornell University; 2. Department of Physics, Cornell University; 3. Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School; 4. Boston Veterans Affairs Healthcare System, Rehabilitation, Research and Development

Contact Email: ecs227@cornell.edu

Primary CNF Tools Used: Oxford ALD FlexAL, AJA Sputter Deposition, ABM Contact Aligner, Oxford 100, PT770 Etcher, Unaxis 770 Deep Si Etcher

2019-2020 CNF Research Accomplishments: Pages 58-59

Neural prostheses have been effective in treating neurological disorders using electrical stimulation through micro-electrodes [1]. However, micro-electrode neurostimulation suffers from the inability to selectively activate neurons based on orientation [2] as well as maintaining long-term functionality [3]. Magnetic stimulation produced by micro-coil devices overcome these issues as the induced electric fields are asymmetric and magnetic fields can pass through biological materials allowing for complete encapsulation. However, the current micro-coil neural probes lack programmable hardware causing the stimulation sites to be fixed after insertion [4]. By codesigning the micro-coil design with CMOS technology mixed-signal circuitry is integrated into the proposed neural probe by implementing a four-wire interface to program which micro-coils are active while also powering the chip and supplying the input current waveforms. Further nanofabrication techniques are applied to release the proposed micro-coils from the original chip packaging to produce a neural probe with spatially programmable micro-coil magnetic stimulation sites. Preliminary in vitro patch-clamp recordings of retinal tissue with have shown controlled neural behavior. Further research exploring the programmable stimulation site regions are ongoing and future neural probes are being design in a CMOS SOI process to utilize circuitry with a higher supply voltage and to further optimize the electric field gradient.

References:

[1] S. J. Bensmaia and L. E. Miller, "Restoring sensorimotor function through intracortical interfaces: progress and looming challenges," Nature Reviews Neuroscience, vol. 15, no. 5, pp. 313–325, 2014.

[2] M. H. Histed, V. Bonin, and R. C. Reid, "Direct activation of sparse, distributed populations of cortical neurons by electrical microstimulation," Neuron, vol. 63, no. 4, pp. 508 – 522, 2009.

[3] V. S. Polikov, P. A. Tresco, and W. M. Reichert, "Response of brain tissue to chronically implanted neural electrodes," Journal of Neuroscience Methods, vol. 148, no. 1, pp. 1 – 18, 2005.

[4] S. W. Lee, K. Thyagarajan, and S. I. Fried, "Micro-coil design influences the spatial extent of responses to intracortical magnetic stimulation," IEEE Transactions on Biomedical Engineering, vol. 66, no. 6, pp. 1680–1694, June 2019.

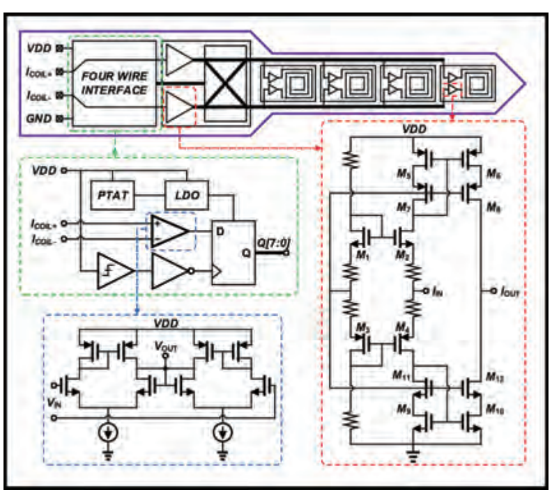

Figure 1: Circuit implementation of the proposed neural probe.

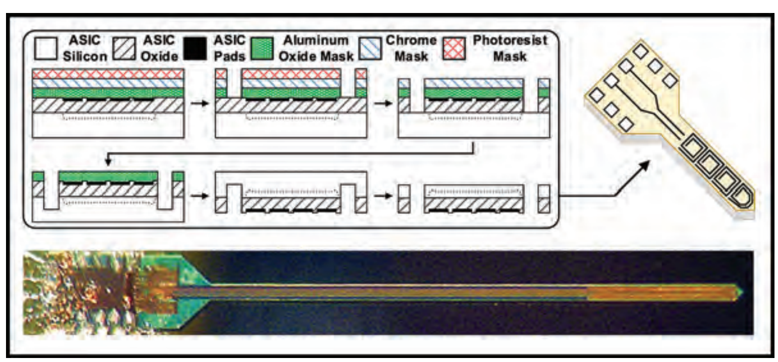

Figure 2: Nanofabrication process to release the neural probe from the initial chip packaging and micrograph of an encapsulated neural probe.

β-Ga_2O_3 Lateral FinFETs Fabrication and Preliminary Devices Performance

Authors: Emma Long, Kathleen Smith, Wenshen Li, Kazuki Nomoto, Grace Xing, Debdeep Jena

CNF Project Number: 2802-91

CNF Principal Investigator: Grace Xing, Debdeep Jena

Department and Institution: Materials Science and Engineering, Cornell University

Contact Email: YL3394@cornell.edu

Primary CNF Tools Used: Autostep i-line Stepper; SC4500 Odd-Hour Evaporator; PT770 Etcher; P-10 Profilometer; Oxford ALD FlexAL; Glen 1000 Resist Strip; Woollam Spectroscopic Ellipsometer

2019-2020 CNF Research Accomplishments: Pages 178-179

As a strong material candidate for high power devices, beta-gallium oxide has the remarkable properties with the high bandgap, breakdown field, and decent electron mobility, which derive a unipolar figure-of-merit (FOM) higher than GaN and 4H-SiC. Besides, the melt-growth techniques enable the mass-producible substrate; the controllable n-type doping can be accomplished by the MOCVD, Mist-CVD, and HVPE. In the past one year, our group developed a high-performance β-Ga_2O_3 vertical FinFETs, which is the first demonstrated multi-fin Ga_2O_3 vertical transistor. It achieved the record FOM of 0.28 GW/cm^2 and breakdown voltage of 2.66 kV [1]. Besides, the lateral MOSFETs on Cornell-grown epi also succeeded in a depletion mode operation. Due to the advantage of lateral finFETs in high-speed operation and thermal management, the goal of this task is to establish process flow for β-Ga_2O_3 lateral FinFETs (Fig.1), achieve enhancement mode operation and the corresponding fin width. Therefore, we designed the fin width at the range of 50 nm to 100 nm according to the theory transited from the planar MOSFET and estimated that the E-mode transition would occur at 50 nm. In the fabrication, we used the Ni as a hard mask during the recess etching, Al_2O_3, and SiO_2 as the dielectric layer, Ti and Au as Ohmic contact, Ni and Au as gate contact. With the observation under SEM, the fins have the dimensions of 300 nm high and 35 to 320 nm wide with smooth sidewalls and sharp edges, which indicated Ni is an excellent hard mask as pattern and protection for recess etching. According to our preliminary measurement, even though the Ohmic contact is relatively poor in this generation, we still found the D-mode to E-mode transition at the fin width near 100 nm (Fig.2) with low leakage and decent subthreshold slope. The current breakdown voltage is around 500 V without additional edge termination design.

References:

1. W. Li, K. Nomoto, Z. Hu, T. Nakamura, D. Jena and H. G. Xing, "Single and multi-fin normally-off Ga_2O_3 vertical transistors with a breakdown voltage over 2.6 kV," 2019 IEEE International Electron Devices Meeting (IEDM), San Francisco, CA, USA, 2019, pp. 12.4.1-12.4.4, doi: 10.1109/IEDM19573.2019.8993526.

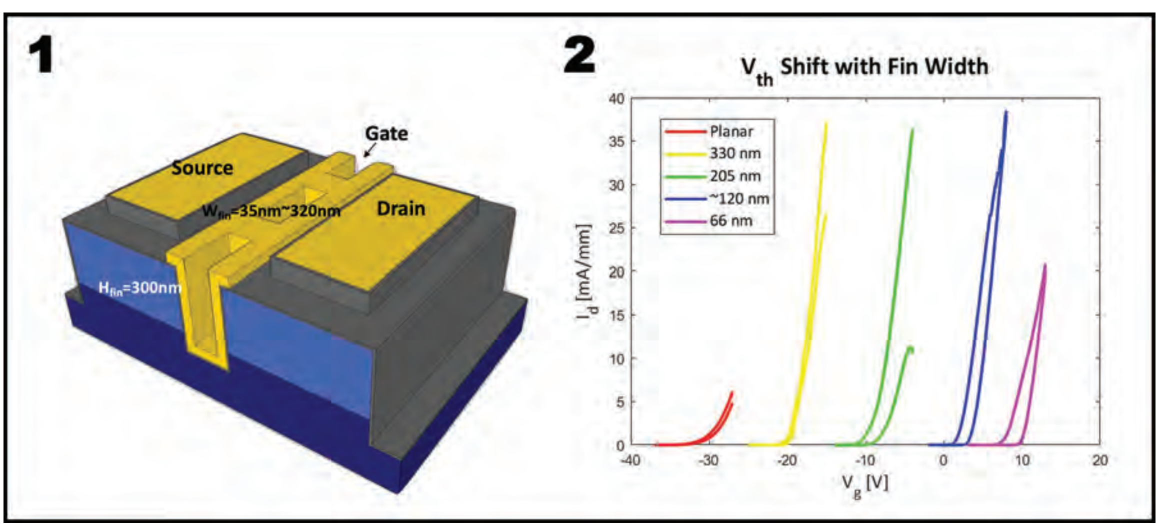

Fig. 1, left: β-Ga_2O_3 lateral FinFETs structure on a (010) Fe doped β-Ga_2O_3 substrate with 200nm 2E18 cm^{-3} Si doped β-Ga_2O_3 grown by MBE at 900°C. Fig. 2, right: Transfer I-V characteristics of the lateral FinFETs with different fin width.

Fabrication & Self-Assembly — Growing Crystal Structures

Authors: M. Martirossyan, J. Dshemuchadse

CNF Project Number: 2794-19

CNF Principal Investigator: J. Dshemuchadse

Department and Institution: Materials Science and Engineering, Cornell University

Contact Email: mmm457@cornell.edu

Primary CNF Tools Used: Nanolab cluster

This talk will consist of two parts; focusing on both my past experience in fabrication and growth as a CNF REU and NNCI iREU intern, as well as my current work in computational soft matter as a PhD student in MSE. At their heart, these projects aim to discover and understand how to grow structurally complex new materials, aiming at new functional materials as a material's properties largely depend on its structure. As a CNF REU, I fabricated differentially stressed SiN_x bilayers with the application of making tunable bandgap semiconductors, and as a NNCI iREU intern I aimed to grow new YbB_x thermoelectric materials. In the Dshemuchadse group, we employ molecular dynamics (MD) simulations to reveal the fundamental mechanisms that drive the growth of materials with complex crystal structures. Currently, the manner in which (often simple) particle-particle interactions lead to the formation of a given crystal structure remains a mystery. Using isotropic, multi-well pair potentials, we can assemble a diverse set of crystal structures and observe the crystallization process. With a machine-learning-powered order parameter, we are able to classify particles into different local environments and track the changes in their environment as crystal growth occurs.

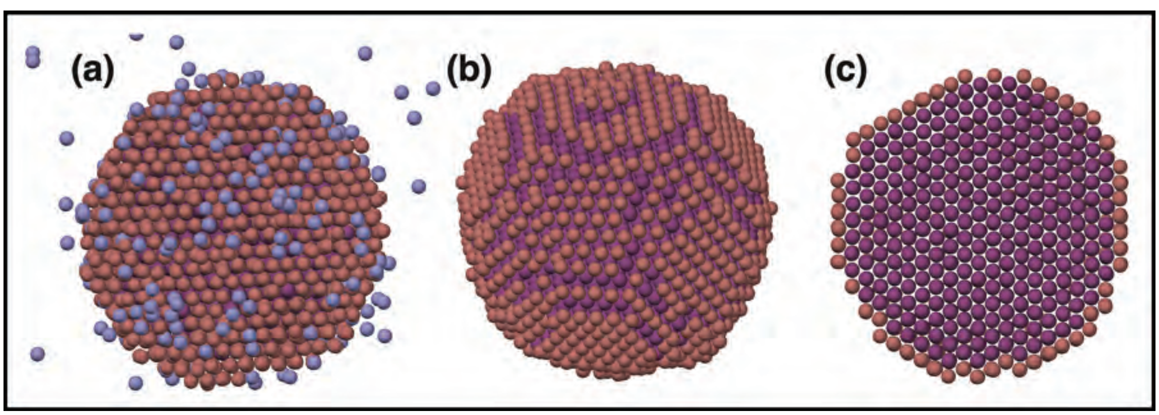

Figure 1: Simulation snapshots of self-assembled crystallites with particles automatically colored by a machine-learning-enabled local order parameter: (a) growing crystal, (b) faceted crystal at low temperature, (c) cross-section in projection along a 3-fold symmetry axis; with particles automatically categorized into bulk (purple), surface (orange), and fluid (violet).

Flexible Hybrid Electronics for the Digital Industrial World

Nancy Stoffel

Horizontal Leader for Flexible Hybrid Electronics, GE Global Research

Contact: stoffel@ge.com

Flexible Hybrid Electronics (FHE) is a set of technologies focused on the integration of heterogeneous sensing, communication, and computational elements to create adaptable and conformable electronic assemblies. The goal of FHE technology is to break through the barriers imposed by today's, largely rigid, electronics "boxes" by blending high performance elements with flexible substrates to create solutions that can adapt to a multitude of geometric and environmental constraints.

Flexible Hybrid Electronics is a paradigm change in both the design and manufacturing of electronic assemblies. It is undergoing a major investment in the industry at large, and is changing the landscape for end users, suppliers, and others across the electronics ecosystem. FHE's rapid pace of change necessitates that we maintain close engagement with the technology to maximize leverage of this growing field for future GE products and services. At GRC our long electronics packaging technology legacy enables us to both contribute key technology components to FHE development and to orchestrate a future supply chain through external partnerships.

This presentation overviews GE's vision of the digital industrial challenges in manufacturing. It shows examples of opportunities for sensors, and communication elements made using flexible hybrid electronics, for smart manufacturing and for improved worker safety and productivity.

Nancy Stoffel specializes in design and manufacturing of printed embedded systems and electronics packaging. She serves as GE's representative on the Nextflex consortia board of governors, and was recognized for her technical contributions by being named a Next Flex Fellow. Nancy holds a PhD in Materials Sciences from Cornell University. Her career has focused on materials and process development for electronics integration. During her 30+ industry career, she was Director of Microsystems Integration at STC MEMS and Technical Manager at Xerox Corp in-charge of inkjet device fluidic design, materials technology and process development for next generation product. During her time at IBM she developed new materials and process technology to create co-fired glass-ceramic multichip modules. She has been with GE Research for seven years where her work has focused on the integration of sensors and electronics for power electronics, wearables and asset monitoring.

:: Poster Information ::

In Order by Last Name of Primary Presenter

Coherent spin-magnon coupling for quantum-to-quantum transduction

Poster Presenter: Hil Fung Harry Cheung
Principal Investigators: Daniel Ralph, Ezekiel Johnston-Halperin, Michael Flatté, Gregory Fuchs
CNF Project: 2126-12
Research Lab and Website: Fuchs Lab, Cornell University, https://fuchs.research.engineering.cornell.edu/

Fabrication Process Simulation with Coventor SEMulator3D at CNF

Poster Presenter: Jeremy Clark, CNF Staff
Research Lab and Website: Cornell NanoScale Facility (CNF), https://cnf.cornell.edu/

Piezoelectric w-AlN Lateral Bimorph: Process Integration

Poster Presenter: Benyamin Davaji
Principal Investigator: Amit Lal
CNF Project: 1122-03
Research Lab and Website: SonicMEMS Laboratory, School of Electrical and Computer Engineering, Cornell University, Ithaca, NY; https://sonicmems.ece.cornell.edu

Scissionable Polymer Photoresist for EUV Lithography

Poster Presenter: Jingyuan Deng
Principal Investigator: Christopher Ober
CNF Project: 2751-18
Research Lab and Website: Ober Group https://ober.mse.cornell.edu/index.html

On-chip Monolayer WSe_2 Microring Laser Operating at Room Temperature

Poster Presenters: Marissa Granados-Baez, Liangyu Qiu, Arunabh Mukherjee
Principal Investigators: Nick Vamivakas, Jaime Cardenas
CNF Project: 2524-17
Research Lab and Website: Cardenas Lab, The Institute of Optics, University of Rochester, https://www.hajim.rochester.edu/optics/cardenas/

Developing a single spin microscope for nanoscale magnetic imaging

Poster Presenter: Qiaochu Guo
Principal Investigators: Greg Fuchs, Katja Nowack
CNF Project: 2126-12
Research Labs and Websites: Fuchs Group https://fuchs.research.engineering.cornell.edu/
Nowack Lab http://nowack.lassp.cornell.edu/

Mechanical stress promotes disassembly of the antibiotic efflux pump MacABTolC

Poster Presenter: Christine Harper
Principal Investigator: Christopher Hernandez
CNF Project: 1970-10
Research Labs and Websites: Hernandez Research Group, Sibley School of Mechanical and Aerospace Engineering, Cornell University; http://www.hernandezresearch.com/

Nano-scale Area-Selective Formation of Binary Polymer Brushes

Poster Presenter: Yuming (Robin) Huang
Principal Investigator: Christopher K. Ober
CNF Project: 1757-09
Research Lab and Website: Ober Research Lab, Cornell University; https://ober.mse.cornell.edu/

Achieving Large Force and Displacement via Silicon Brush Drive Actuator

Poster Presenter: Landon Ivy
Principal Investigator: Dr. Amit Lal
CNF Project: 1262-04
Research Lab and Website: SonicMEMS Laboratory, School of Electrical and Computer Engineering, Cornell University, Ithaca, NY, USA; https://sonicmems.ece.cornell.edu/

Nano-confinement Polymerization Kinetics in Porous Membranes

Poster Presenter: Alexandra Khlyustova
Principal Investigator: Rong Yang
CNF Project: 2765-19
Research Lab and Website: The Yang Lab at Cornell University, Laboratory for Bio-Interface Engineering; https://theyanglab.com/

Enhancing Nuclear Spin Coherence with a Diamond Bulk Acoustic Resonator

Poster Presenters: Johnathan Kuan, Anthony D'Addario, Huiyao Chen, Gregory Fuchs
Principal Investigator: Gregory Fuchs
CNF Project: 2126-12
Research Lab and Website: Fuchs Lab at Cornell University, https://fuchs.research.engineering.cornell.edu/

An Array Microhabitat Platform with Environmental Control for Studying HABs

Poster Presenters: Fangchen Liu*, Nicole Wagner, Mohammad Yazdani, Daniel Vitenson, Beum Jun Kim, Beth Ahner, and Mingming Wu
Principal Investigator: Dr. Mingming Wu
CNF Project: 2262-13
Research Lab and Website: Biofluidics Lab, Biological and Environmental Engineering https://biofluidics.bee.cornell.edu/

ß-Ga_2O_3 Lateral FinFETs Fabrication and Preliminary Devices Performance

Poster Presenter: Emma Long
Principal Investigators: Grace Xing, Debdeep Jena
CNF Project: 2802-91
Research Lab and Website: Materials Science and Engineering department, Cornell University, Jena-Xing Group (http://grace.engineering.cornell.edu/) (https://www.mse.cornell.edu/mse)

Quantum Emitter Creation and Optomechanical Coupling in Hexagonal BN Membranes

Poster Presenter: Nikhil Mathur
Principal Investigator: Gregory Fuchs
CNF Project: 2126-12
Research Lab and Website: Fuchs Group, School of Applied and Engineering Physics; https://fuchs.research.engineering.cornell.edu

Cryogenic Small Angle X-Ray Scattering

Poster Presenters: David W. Moreau, Jonathan Clinger, Robert Thorne
Principal Investigator: Robert Thorne
CNF Project: 2157-12
Research Lab and Website: Thorne Lab, Cornell University; http://www.lassp.cornell.edu/Thorne/

Single-shot, Multiple I/O Photonic Chip to Fiber Array Packaging Using Fusion Splicing

Poster Presenter: Juniyali Nauriyal
Principal Investigator: Jaime Cardenas
CNF Project: 2524-17
Research Lab and Website: Cardenas Lab for Nanoscale and Integrated Photonics;
https://www.hajim.rochester.edu/optics/cardenas/

Optically Powered Microscopic Bubble Rockets

Poster Presenters: Samantha Norris, Michael Reynolds
Principal Investigator: Paul McEuen
CNF Project: 900-00
Research Lab and Website: McEuen Group, Cornell University http://mceuengroup.lassp.cornell.edu/

Progress in Metal-Organic Cluster Photoresists for EUV Lithography

Poster Presenter: Yusuke Otsubo
Principal Investigator: Christopher K. Ober
CNF Project: 386-90
Research Lab and Website: Ober group, Department of Materials Science and Engineering, Cornell University;
https://ober.mse.cornell.edu/

Making Microrobots with CMOS Control Circuits

Poster Presenters: Michael F. Reynolds; Co-authors: Alejandro J. Cortese, Qingkun Liu, Wei Wang, Samantha L. Norris, Sunwoo Lee, Marc Miskin, Aloysha Molnar, Itai Cohen, Paul L. McEuen
Principal Investigator: Paul L. McEuen
CNF Project: 900-00
Research Lab and Website: McEuen Group, Cornell University; http://mceuengroup.lassp.cornell.edu/

Magnetic field detection limits for ultraclean graphene Hall sensors

Poster Presenter: Brian Schaefer
Principal Investigator: Katja Nowack
CNF Project: 2361-15
Research Lab and Website: Nowack Lab, Laboratory of Atomic and Solid State Physics,
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Enhanced on-chip phase measurement by weak value amplification

Poster Presenter: Meiting Song
Principal Investigator: Jaime Cardenas
CNF Project: 2524-17
Research Lab and Website: Cardenas Lab, the Institute of Optics, University of Rochester;
https://www.hajim.rochester.edu/optics/cardenas/

Neural Probe Utilizing Micro-coil Magnetic Stimulation with CMOS Technology Integration for Spatially Programmable Neurostimulation

Poster Presenter: Edward Szoka
Principal Investigator: Alyosha Molnar
CNF Project: 2847-19
Research Lab and Website: Molnar Group (https://molnargroup.ece.cornell.edu/)

Cornell Institute of Biotechnology – Biotechnology Resource Center

Poster Presenters: James VanEe, Teresa Porri
Director: Matt DeLisa, Institute Director
Research Lab and Website: Cornell Institute of Biotechnology / www.biotech.cornell.edu

Core Facilities at the Cornell Institute of Biotechnology's Biotechnology Resource Center (BRC) provide Genomics, Proteomics, Metabolomics, Imaging, Flow Cytometry and Bioinformatics Support for the research community within cornell as well as external academic and industry users.

Electrically actuated artificial cilia for microfluidic applications

Poster Presenter: Wei Wang
Principal Investigator: Itai Cohen
CNF Project: 2416-16
Research Lab and Website: Cohen Lab, Department of physics: http://cohengroup.lassp.cornell.edu/

Machine learning for predicting the performance of photolithography

Poster Presenters: Yixuan Wang, Xinru Zhang, Yifei Xu, Gengqiao Xie, Benyamin Davaji
Principal Investigators: Peter Doerschuk, Amit Lal
CNF Project: SEMI-AI
Research Labs and Websites: Doerschuk Research Group, School of Electrical and Computer Engineering, and Meining School of Biomedical Engineering, Cornell University, Ithaca, NY, USA; https://doerschuklab.bme.cornell.edu/; SonicMEMS Laboratory, School of Electrical and Computer Engineering, Cornell University, Ithaca, NY, USA; https://sonicmems.ece.cornell.edu

Micron-sized Electrically Programmable Shape Memory Actuators and Structures

Poster Presenter: Qingkun Liu
Principal Investigators: Itai Cohen and Paul McEuen
CNF Project: 2416-16
Research Labs and Websites: Itai Cohen Group, http://cohengroup.lassp.cornell.edu/; Paul McEuen Group, http://mceuengroup.lassp.cornell.edu/

Imaging Nanoscale Magnetization Using Scanning-probe Magneto-thermal Microscopy

Poster Presenter: Chi Zhang
Principal Investigator: Gregory David Fuchs
CNF Project: 2091-11
Research Lab and Website: Fuchs Group, Applied and Engineering Physics, Cornell University; https://fuchs.research.engineering.cornell.edu/

Development of Metamaterial Filters for Astronomical Instruments

Poster Presenters: Bugao Zou, Nick Cothard
Principal Investigator: Gordon Stacey
CNF Project: 2458-16
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