CNF 45 YEARS

Cornell NanoScale Science and Technology Facility

2022 CNF 45TH Anniversary Celebration & Annual Meeting

Tuesday, October 18, 2022

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CNF 45th Anniversary Celebration & Annual Meeting

Tuesday, October 18, 2022
Cornell University Campus

7:30-8:15 AM, Registration & Hot Breakfast Buffet, (Foyer & G10 Biotechnology)

Session Chairs, All Day: CNF Directors Fischbach, Ober & Olson

8:15-8:30 AM, CNF Directors' Welcome (G10 Biotechnology Building)..... page 6
Christopher Kemper Ober, Lester B. Knight Director
Claudia Fischbach, Associate Director
Ron Olson, CNF Director of Operations

8:30-8:45 AM, A Selection of CNF 45th Anniversary Shout Outs! (Very Brief History, page 5)

8:45-9:25 AM, Plenary Speaker Dr. Mathieu Foquet,
Principal Scientist, Pacific Biosciences..... page 7
"The Evolution of SMRT Sequencing"

9:25-9:40 AM, Break

9:40-10:05 AM, Prof. Sharon Gerecht,
Biomedical Engineering, Duke University..... page 8
"Examples of Micro and Nanotechnology in Regenerative Medicine and Cancer Research"

10:05-10:30 AM, Prof. Itai Cohen,
Physics Department, Cornell University ..... page 9
"Electronically Integrated Microscopic Robots"

10:30-10:55 AM, Nancy Stoffel,
Horizontal Leader-Flexible Hybrid Electronics, GE Global Research..... page 10
"Printed Hybrid Electronic Integration for Industrial and Medical Uses"

10:55-11:20 AM, Prof. Abraham Stroock,
Smith School of Chemical and Biomolecular Engineering, Cornell University . page 11
"Programmable Plants and the Internet of Living Things"

11:20-11:45 AM, Travel Time to Statler Hotel

11:45-12:45 PM, Lunch Buffet (Statler Hotel Ballroom)

5:00-6:30 PM, Poster Session & Corporate Soiree (Duffield Hall Atrium)

A Very Brief History of the CNF!

The Cornell NanoScale Science & Technology Facility (CNF) had its beginnings within the National Science Foundation (NSF) during the mid-1970s. In 1976, NSF held country-wide workshops to assess the need for a university-based national research and resource facility for submicron structures (NRRFSS). As a result, NSF issued a request for proposals. The winning proposal came from Cornell University and was promoted and coordinated by Prof. Joseph M. Ballantyne, School of Electrical and Computer Engineering.

To facilitate the creation of NRRFSS in 1977, Cornell appointed Prof. Ballantyne as Acting Director, assembled a Program Committee to advise him on equipment and program issues, and rallied faculty to respond to the five-year $5-million grant that provided for $2 million dollars in equipment purchases, and $750 thousand dollars per year for four years of program support. Dr. Edward D. Wolf became NRRFSS director in July 1978.

During the first several years, the focus was on securing full-time technical staff to operate and repair the growing capital equipment investment (the 2016 replacement price is about $ 45M) and to design and build a cleanroom facility that would be durable. In fall of 1981, CNF moved into a $4.2M facility with a 7,500 square foot cleanroom. Its construction, and subsequently the directorship, was endowed by Lester B. Knight (Cornell '29). This successful period of growth and transition was possible only through the unfailing interest and support of a core group of Cornell faculty from ECE, AEP, and MSE.

Over the next fifteen years (1982-1997), the operation of the facility remained at a nearly steady state with about twenty full-time staff members servicing as many projects as was humanly possible. Lester B. Knight directors Prof. Harold Craighead (1989-1995) and Prof. Noel MacDonald (1995-1997), and Associate Director Prof. Alton Clark (1994-2000) led the staff in successful tool upgrades, funding proposals, and many many visits, tours, and conferences advancing nanoscience.

The long term success of the facility is primarily the result of a talented and persevering staff that often works well into the night during the short visits by researchers from around the world. CNF staff must astutely bridge the gap between wishful thinking by users and what is possible. They are, or become, the resident expert in their particular area of nanofabrication. The user generally leaves satisfied and impressed, and the facility advances in its capability with a greater appreciation of the wide range of user needs.

In 1993, NSF enlarged the funding and number of nanofabrication facilities. Cornell University won the competition for the National Nanofabrication Users Network (NNUN) with CNF as a key facility among five other laboratories. In 1998, the NNUN was notified of another five years of funding. It is only fitting that Prof. Ballantyne, who was key in winning the original 1977 competition, was at the helm as director again.

In 2003, Cornell University was honored to become a member of the National Nanotechnology Infrastructure Network (NNIN) competition. This expanded network included 12 sites and one affiliate. In 2009, we were furthered honored by the NSF's renewal of the NNIN funding, but now with 14 members.

During that period, CNF Director Prof. Sandip Tiwari (1999-2005) became NNIN Director too. In 2006, Prof. John Silcox came on board as interim director until Prof. George Malliaras (2007-2009) stepped up. In addition, Don Tennant was hired as Director of Operations.

CNF Director Prof. Dan Ralph (2009-2016) led Cornell's effort to become a member of the 16-site National Nanotechnology Coordinated Infrastructure (NNCI).

In July 2016, the CNF welcomed our newest Lester B. Knight Director — Professor Christopher Ober. Prof. Ober stated, "As the new CNF Director, I am excited about the new job and about the new opportunities afforded by the creation of the NNCI, a network focused on nanoscience and nanotechnology. As the users of CNF know, we have first-rate facilities and outstanding staff who are dedicated to helping our users achieve success in all their efforts. As a long time user of CNF myself, I am always very impressed with the enthusiasm of the staff for teaching new users and working with them to solve interesting and often difficult problems. We welcome inquiries from all researchers about CNF's capabilities and the new network."

Today, the leadership includes Prof. Ober (MSE, 2016-), Mr. Ron Olson, Director of Operations (2019-), Prof. Claudia Fischbach (BME, 2020-), Associate Director, and of course — Dr. Lynn Rathbun, who continues his important management role in CNF (1979-!!!!).

We now have a "Directors Wall" online -- https://www.cnf.cornell.edu/about/directors_wall

CNF serves well over 600 regular users in a year across a broad range of subject areas. With such a diverse user membership, the impact of CNF can be felt across the entire research landscape. It is noteworthy that CNF continues to provide uniquely enabling technology for a wide spectrum of science and engineering research at a university, founded by Ezra Cornell, under the motto,

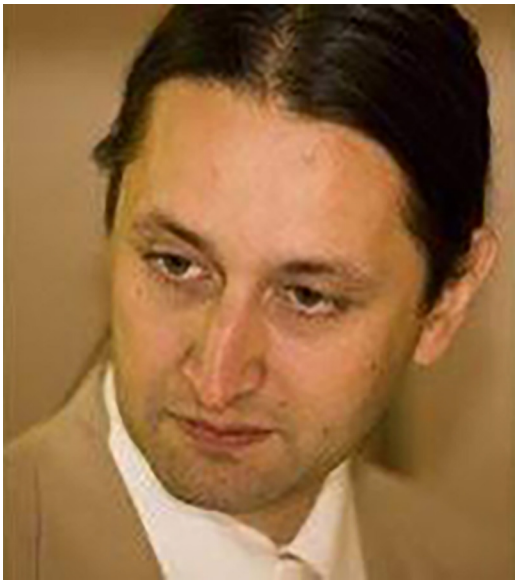
"I would found an institution where any person can find instruction in any study."
- Ezra Cornell

Christopher Ober, Francis Bard Professor of Materials Engineering, and Lester B. Knight Director, 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.

Claudia Fischbach, 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 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.

Ron Olson, 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.

"The Evolution of SMRT Sequencing"



Mathieu Foquet

Principal Scientist, Pacific Biosciences

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Abstract:

Pacific Biosciences has developed a unique DNA sequencing technology, Single-Molecule Real-time (SMRT) Sequencing. It is based on intellectual property originally from Cornell, and prototype devices manufactured right here at CNF. In this talk, after a quick overview of SMRT sequencing basics, centered around our use of nature's own technology to read and reproduce DNA, we will review how the convergence of three technology platforms, digital image sensors, integrated photonics and microfluidics enabled the full promise of SMRT sequencing.

Digital image sensors have become ubiquitous, and their availability at low cost is one of the keys to our technology, forming a base for all our current devices. The development of on-wafer integrated photonic components allowed us to move beyond the original device, the Zero-Mode Waveguide (ZMW) and enable a truly fully integrated platform. In particular, the rise of datacom, moving away from the IR wavelength of telecom has proven to also been very enabling for life-science applications of photonic integration. And of course, the rise of a mature established microfluidics industry allows us to smoothly blend the biochemistry world to the semiconductor world.

This convergence of multiple technologies, which only occurred in the last 10 years, lead Pacific Biosciences to develop its SequEl and SequelII sequencing platforms. These novel platforms put Pacific Biosciences in an ideal place to become the gold standard reference genome builders of the sequencing market, combining high accuracy, long read length and completeness of the genomes.

Biography:

Mathieu Foquet graduated from his alma mater, the Free University of Brussels, in 1996, with a degree in applied engineering physics. He immediately joined the doctorate program at the Applied and Engineering School of Cornell University. It is there that his interest in biophysics, and in particular the use of micro and nanofabrication techniques for studying biologically relevant problem developed. Upon completion of his thesis in 2002 on the use of nanofabricated devices for single molecule detection and a short post-doctoral period, he joined Pacific Biosciences. Pacific Bioscience was then a startup based on intellectual property from Cornell University. He remains at Pacific Biosciences to this day, working on developing its Single-Molecule Real-Tine sequencing technology. Particularly, he was a key manager and technical lead for developing the SequEl platform, the first Pacific Bioscience platform integrating all optical function of its detection process on a single chip.

"Examples of Micro and Nanotechnology in Regenerative Medicine and Cancer Research"

Sharon Gerecht, Ph.D.

Paul M. Gross Distinguished Professor of Biomedical Engineering

Associate Dean for Research and Infrastructure

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Abstract:

Cell differentiation, tissue formation, and regeneration occur in a complex milieu. Disruption of physicochemical cues in the cell microenvironment can compromise homeostasis, leading to tissue dysfunction. For example, nanoscale topographic features of the extracellular matrix regulate cell fate, organization, and motility. In this talk, I will present several examples of how we incorporate micro- and nanotechnology to recapitulate physicochemical cues in the cell microenvironment to understand cellular responses and harness these to engineer and manipulate cells.

Biography:

Dr. Sharon Gerecht is the Paul M. Gross Distinguished Professor of Biomedical Engineering at Duke University. She is currently serving as the Associate Dean for Research and Infrastructure at Pratt School of Engineering at Duke University. She is a global expert in vascular and stem cell biology and engineering, including pioneering engineering principles to understand and harness cell fate decisions for therapeutic developments. She and her lab team study how the microenvironment modulates stem cell fate, differentiation, and tissue assembly. These include understanding how various properties of the extracellular matrix modulate cellular responses and how oxygen gradients regulate tissue performance. They develop biomaterials to guide morphogenesis through sequential activation of signaling pathways to form functional tissues and use a range of disease and injury models to delineate these mechanisms in vivo.

Dr. Gerecht is the recipient of the Allan C. Davis Medal from the Maryland Academy of Sciences (2008), the North America Vascular Biology Organization Junior Investigator Award (2009), the Basil O'Connor Starter Scholar Research Award from the March of Dimes Foundation (2009-2011), the National Scientist Development Award (2008-2012) and Established Investigator Award (2014-2019) both from the American Heart Association, the National Science Foundation CAREER award (2011-2016), the W.W. Smith Charitable Trust Heart award (2014-2017), and the Johns Hopkins University Inaugural President's Frontier Award (2015). Dr. Gerecht is an elected Fellow of the American Institute for Medical and Biological Engineering (2016), an elected Member of the National Academy of Medicine (2019), and an elected fellow of the American Association for the Advancement of Sciences (2020) and the National Academy of Inventors (2020). She is the author of more than 200 papers, book chapters, and patents in her field.

"Electronically Integrated Microscopic Robots"

Itai Cohen

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Abstract:

What would we be able to do if we could build electronically integrated machines the at a scale of 100 microns? At this scale, semiconductor devices are small enough that we could put the computational power of the spaceship Voyager onto a machine that could be injected into the body. Such robots could have on board detectors, power sources, and processors that enable them to sense, interact, and control their local environment. In this talk I will describe several cutting edge technologies we are developing to achieve this vision.

Biography:

Professor Itai Cohen studies the physics of matter in motion. At Cornell, his research has focused on building microscopic robots, controlling the shear thickening behavior of microscopic and nanoscopic particles suspended in a fluid, exploring the mechanics of materials ranging from biological tissues to origami inspired metamaterials, discovering the aerodynamic and neuromuscular mechanisms used by insects during flapping flight, and determining how audiences at heavy metal concerts coordinate their movement. Understanding how emergent behaviors arise from the microscopic rules governing these systems remains one of the biggest challenges in Physics.

Professor Cohen received his BS in Physics from the University of California at Los Angeles, and his PhD in Physics from the University of Chicago. Following his graduate studies, he was a Post-doctoral fellow in Physics and the Division of Engineering and Applied Science at Harvard University. In 2005 he joined Cornell and is currently a professor of Physics. Professor Cohen is an NSF Career grant recipient, he is a Fellow of the American Physical Society, and is the recipient of the Kappa Delta Ann Doner Vaughn Award for his work on cartilage mechanics. He has served as a Feinberg and Braginsky fellow (2012) and the Rosi and Max Varon Visiting Professor at the Weizmann Institute (2021) and the van der Waals Visiting Professor at the University of Amsterdam (2022). He has published over 110 research articles, given nearly 300 invited seminars, colloquia and conference presentations, and co-authored the book Finding Your Research Voice: Story Telling and Theater Skills for Bringing Your Presentation to Life. His work has been covered by various outlets ranging from the BBC, to Scientific American, NPR, and the NYTimes.

"Printed Hybrid Electronic Integration for Industrial and Medical Uses"

Dr. Nancy Stoffel

Electronic Systems, GE Research

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Website: www.ge.com/research/

Abstract:

Printed hybrid electronics is a nascent approach to electronics system integration. It has special appeal to applications where the production of a flexible, robust or large format article would be advantageous. In PHE, Printing technologies can be used to create conductive traces, passives such as resistors, inductors and capacitors, RF structures such as antenna, and actuators. Complex electronic devices are incorporated through use of silicon microelectronics, MEMS, as well as power or optoelectronics. Printed hybrid electronics involves creation of electronic systems that fit into the world, whether as a wearable medical patch, a sensing system on an engine, the blade on a wind turbine, or a system built into the infrastructure of your home. The substrate may be thin, bendable, and stretchable or it may be a large metal piece. In this talk, I will cover the fundamental approaches and applications of flexible hybrid electronics in projects at GE Research and application areas in industrial applications including Healthcare, Power, and Aerospace.

Biography:

Dr. Nancy Stoffel holds a PhD in Materials Science from Cornell University. Her career has focused on materials, process development and reliability for electronics integration. During her 30+ year industry career, she has worked at a variety of companies and held roles in both management and technology leadership. Currently Nancy specializes in design and manufacturing of printed electronic systems and electronic packaging. She works both internally and through external companies and collaborators to mature technologies useful for GE sensing systems. She has also worked at Xerox, Infotonics, and IBM. Nancy is also active in the IEEE Electronics Packaging Society where she is on the Executive Committee for ECTC. Nancy remains tied to Cornell through service on a number of advisory boards including the Cornell Center for Materials Research, CNF, and the Materials Science Department.

"Programmable Plants and the Internet of Living Things"

Abe Stroock

Smith School of Chemical and Biomolecular Engineering, Cornell University

NSF STC – Center for Research on Programmable Plant Systems (CROPPS)

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Abstract:

Plant life plays critical roles in regulating the earth's climate and as the primary source of food and energy for all living things. Human's understanding of and interactions with plants need to become more sophisticated to improve the sustainability, resilience, and productivity of agriculture and mitigate the negative impacts of climate change on natural and managed ecosystems. Micro- and nanotechnologies have important potential applications in this area, for discovery and application in both crop management and breeding. I will present a brief overview of the vision of the Center for Research on Programmable Plant Systems (CROPPS – NSF STC) for a transdisciplinary effort to develop an Internet of Living Things (IoLT) in which micro-, nano-, and biotechnologies allow integration with plants to provide access to their deep biology for sensing and actuation. I will provide example from my lab on the development of a MEMS sensor for continuous, in-plant monitoring of water stress and a nanomaterial for tracking these stresses in critical tissues within the leaf. These examples will illustrate the value of learning from the target biological system for the design on an appropriate, effective technology and the challenges and opportunities for the integration of devices into a field-ready IoLT for research and commercial applications.

Biography:

Abe Stroock is a professor in the Smith School of Chemical and Biomolecular Engineering and adjunct professor in the School of Integrative Plant Sciences at Cornell. He is the director of the NSF-STC Center for Research on Programmable Plant Systems. After completing a bachelor's degree in Physics at Cornell, Stroock spent two years in France where he worked in the research division of Electricite de France and completed a master's degree at the University of Paris VI and XI in Solid State Physics. He then returned to the US to pursue a PhD in the Chemistry department at Harvard University. The Stroock lab focuses on manipulating and measuring dynamics and chemical processes on micrometer scales with an emphasis on biophysical contexts. Current efforts in the lab center around the transport, thermodynamics, and physiology of water in plants and in synthetic systems inspired by plant function.

Prof. Emmanuel P. Giannelis

Vice President for Research and Innovation,
Walter R. Read Professor of Engineering,
Cornell University

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Emmanuel Giannelis serves as Vice President for Research and Innovation. He leads the Research Division on the Ithaca Campus and, across all Cornell campuses, is responsible for technology transfer, intellectual property, and research policy. In this dual role, he reports to the Provost and to the President.

The Office of the Vice President for Research and Innovation (OVPRI) enables and advances Cornell research priorities, including research activities of Cornell colleges, schools, and research centers, institutes, and laboratories. The OVPRI advocates for researchers within the university, working with external agencies, sponsors, and government representatives; supports specialized research facilities and services for researchers; provides campus-wide research administrative support services; and facilitates major interdisciplinary research initiatives.

In his university-wide role, Giannelis, along with Cornell's Center for Technology Licensing (CTL) and the Office of Corporate Engagement (OCE), champions innovation, entrepreneurship, and technology commercialization. The OVPRI, CTL, and OCE support researchers and entrepreneurs to translate scientific discoveries, technological innovations, medical advances, and new products to the marketplace. The goal is to accelerate the impact of research to society, to foster economic development within New York State and across the nation and to further Cornell's land grant mission.

Giannelis joined the Department of Materials Science and Engineering at Cornell in 1987, where he is currently the Walter R. Read Professor of Engineering. He received a BS degree in chemistry from the University of Athens (Greece) in 1980 and a PhD in chemistry from Michigan State University in 1985. His recent research focus is on design and application of nanomaterials for energy, biomedicine, and the environment.

Giannelis is a member of the European Academy of Sciences, a fellow of the American Chemical Society, and a fellow of the Polymer Materials Science and Engineering Division of the American Chemical Society. He received the Cooperative Research Award from the American Chemical Society in 2014. He was awarded a Doctorat Honoris Causa (honorary PhD) in July 2017 from the Institut National des Sciences Appliquées de Lyon, Université de Lyon.

"Hybrid Quantum Devices Using a Superconducting Resonator and Low-Damping Magnons in an Integrated Platform"

Gregory. D. Fuchs

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Abstract:

Hybrid quantum systems – in which quantum excitations of distinct origin are hybridized through a resonant interaction – are attractive for quantum technologies because they enable tunability and the ability to combine desirable properties of each excitation. Here we study the hybrid excitation of a superconducting microwave resonator mode and a ferromagnetic resonance mode of vanadium tetracyanoethylene (V[TCNE] x) thin films. Our work addresses a key challenge for hybrid resonator-magnon devices: the integration of a low damping thin-film material with microfabricated superconducting circuits. V[TCNE]x is a molecular-based ferrimagnet with exceptionally low magnetic damping – the Gilbert damping coefficient is as low as 5×10–5 at room temperature. The ability to grow thin films of this material at low temperature via chemical vapor deposition and pattern it via lift-off processing enables the fabrication of integrated quantum magnon devices in a scalable, integrated platform. We couple a V[TCNE]x magnon mode to the mode of a thin-film Nb lumped-element LC resonator and demonstrate strong coupling, characterized by cooperativities in above 103. Characterization of this hybrid resonator-magnon system in both the frequency domain and the time domain reveals hybridization between resonator photons and magnons. This work demonstrates a pathway for scalable and integrated quantum magnonic technologies.

Biography:

Fuchs earned his Ph.D. in Applied Physics from Cornell University in 2007. Afterward, he moved to the University of California, Santa Barbara as a postdoctoral associate. In 2011, he joined the Cornell faculty of Applied and Engineering Physics. In 2012 he received a Young Investigator Award from the Air Force Office of Scientific Research, in 2013 he received an Early Faculty Career Award from the National Science Foundation along with the Presidential Early Career Award for Scientists and Engineers, and in 2014 he received the Early Career Award from the Department of Energy.

"Embracing Complexity for Enduring and Adaptive, Organic Robots via Autonomous Materials"

Prof. Robert F. Shepherd

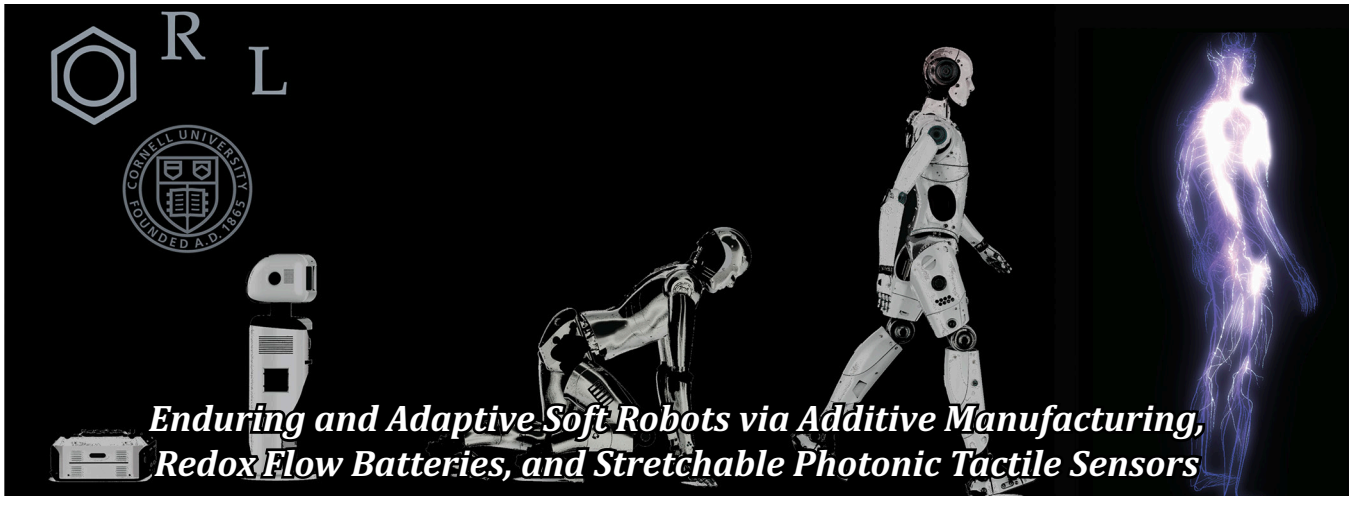
Associate Professor, Sibley School of Mechanical and Aerospace Engineering, Cornell University, rfs247@cornell.edu

Abstract:

Controlling soft robots is difficult. The infinite passive degrees of freedom in elastomeric actuators presents variability in the control architecture that is computationally expensive to overcome, or sometimes intractable without external motion capture. In animals, this problem is solved with large numbers of redundant mechanoreceptors for tactile perception and kinesthetic sense. Existing devices for tactile sensing (i.e., pneumatic, hydraulic, electrical load cells) could make the benefits of using soft robots (adaptability, conformability, simplicity) irrelevant at the densities required for accurate feedback control. As a result, significant efforts have been put forth towards soft strain gauges that can become part of the robot's elastomeric body without reducing its performance. These sensors are typically electrical (i.e., resistive or capacitive), which creates material requirements that can be limiting—good stretchable conductors are still an intense area of research. In 2016, we began using stretchable lightguides as a photonic solution to tactile perception in soft robots. The use of photons, instead of electrons provides new material opportunities for soft strain gauges. This talk will discuss the synthesis, fabrication, and use of materials for these stretchable photonic solutions that we call Light Lace. Further, this talk will discuss the multifunctional use of energy as hydraulic force transmission and electrical energy storage, increasing the operational lifetime of robots. This method is more general and will be discussed under the context of embodied energy and a framework for future improvements in endurance and agility of robots will be presented.

Biography:

Rob Shepherd is an associate professor at Cornell University in the Sibley School of Mechanical & Aerospace Engineering. He received his B.S. (Material Science & Engineering), Ph.D. (Material Science & Engineering), and M.B.A. from the University of Illinois in Material Science & Engineering. At Cornell, he runs the Organic Robotics Lab (ORL: http://orl.mae.cornell.edu), which focuses on using methods of invention, including bioinspired design approaches, in combination with material science to improve machine function and autonomy. We rely on new and old synthetic approaches for soft material composites that create new design opportunities in the field of robotics. Our research spans three primary areas: bioinspired robotics, advanced manufacturing, and human-robot interactions. He is the recipient of an Air Force Office of Scientific Research Young Investigator Award, an Office of Naval Research Young Investigator Award, and his lab's work has been featured in popular media outlets such as the BBC, Discovery Channel, and PBS's NOVA documentary series. He is an advisor to the American Bionics Project (americanbionics.org) which aims to make wheelchairs obsolete. He is also the co-founder of the Organic Robotics Corporation (ORC; lightlace.io), which aims to digitally record the tactile interactions of humans and machines with their environment.



Let's Do Work that Matters: Nanoscience at the Center for Functional Nanomaterials, a DOE Scientific User Facility

Charles Black

Center for Functional Nanomaterials,
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Abstract:

The Center for Functional Nanomaterials (CFN) is a national scientific user facility operated at Brookhaven National Laboratory for the U.S. Department of Energy. One of five DOE Nanoscale Science Research Centers, the CFN mission is to support the worldwide community by providing leading capabilities & expertise, and making breakthrough nanoscience contributions to national science initiatives through research.

I will briefly present some perspectives on the role of nanoscience in today's research ecosystem, viewed through the lens of the now 20+ years of the U.S. National Nanotechnology Initiative. As a nanoscience community, we can be proud of our many advances in chemistry, materials, biology, and instrumentation, while also recognizing and fully embracing the challenge of helping to solve the most important issues in today's world.

Tackling these daunting challenges will require the scientific community to work together in new ways, and scientific user facilities like the CFN and the Cornell Nanofabrication Facility have a vital role to play — because of their foundational culture of collaboration. Let's resist the urge to leave solving impossible problems to others, because there are so many important challenges for which science must provide the answer. Let's work together and make a difference.

Biography:

I am the Director of the Center for Functional Nanomaterials (CFN) at Brookhaven National Laboratory, where I am also a Senior Scientist. The CFN is a national scientific user facility, which we operate for the U.S. Department of Energy (DOE) as a resource for the worldwide scientific community. Prior to becoming Director, I was a Group Leader in the CFN, responsible for setting research directions using nanostructured electronic materials for clean energy. From 1996 to 2006, I was a Research Staff Member at the IBM Thomas J. Watson Research Center in Yorktown Heights, New York, where my collaborators and I pioneered using polymer self-assembly for high-resolution patterning in semiconductor electronics. In my 25-year career so far, I have also at different times performed research in: superconductivity of nanoscale materials; nanocrystal-based materials and devices; low-temperature scanning tunneling microscopy; and ferroelectric non-volatile memories. From 2015–17, I was a Member of the Board of Directors of the Materials Research Society. I am a Fellow of the American Physical Society and a Senior Member of the IEEE. I earned a Ph.D. degree in Physics from Harvard University in 1996, studying with Professor Michael Tinkham. I earned B.S. degrees in Physics and Mathematics from Vanderbilt University in 1991.

"Integrated Optical Control of Atomic Quantum Systems"

Karan Mehta

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Abstract:

Practical quantum information processing requires significant advances over current systems in error and robustness of basic operations, and in scale. The fundamental qualities of trapped atomic ion qubits are promising for long-term systems, and have enabled leading systems in both academic and commercial efforts today. The optics required have however presented a central challenge in scaling. Interfacing low-noise atomic qubits with scalable integrated photonics [1] has emerged as a promising route forward, enabling practical extensibility while simultaneously lending robustness to noise . After a brief introduction to trapped-ion QC, I will discuss recent experiments utilizing ion trap devices with integrated waveguide optical delivery, demonstrating methods that facilitate scaling while simultaneously reducing key sources of error in sensitive quantum logic operations [2]. I will discuss novel possibilities for basic quantum operations enabled by structured light profiles practically delivered with such approaches; opportunities and challenges in photonics posed by applications in atomic systems [3]; and possibilities at this interface to advance future experiments in areas including sensing and precision metrology.

References:

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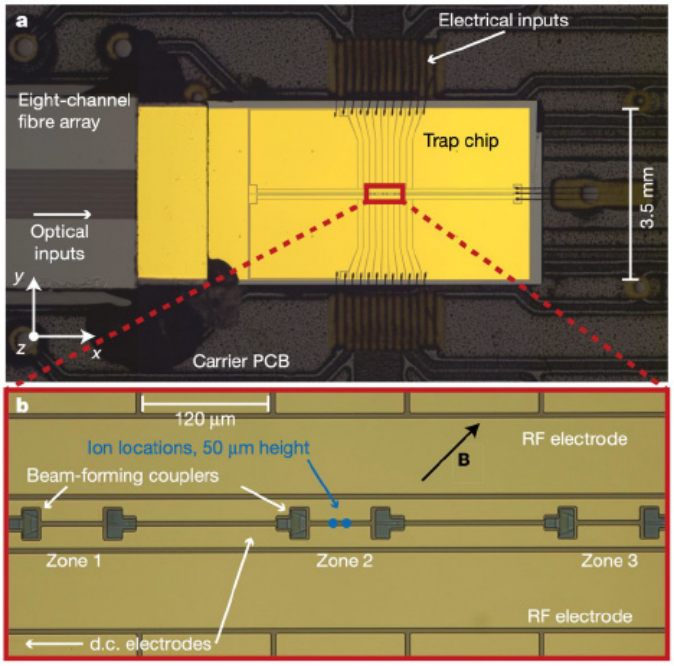
[2] K.K. Mehta, C. Zhang, M. Malinowski, T.-L. Nguyen, M. Stadler, and J.P. Home. "Integrated optical multi-ion quantum logic." Nature 586, 533-537 (2020).

[3] L. Massai, T. Schatteburg, J.P. Home, and K.K. Mehta. "Pure circularly polarized light emission from waveguide microring resonators." Applied Physics Letters 121, 121101 (2022).

Biography:

Karan Mehta received BS. Degrees from UCLA in Physics and Electrical Engineering in 2010, and completed his PhD in Electrical Engineering and Computer Science at MIT in 2017, with the support of a DOE Science Graduate Fellowship. From 2017 to 2021 he was an ETH Postdoctoral Fellow, and subsequently senior scientist, in the Physics department at ETH Zurich. He joined Cornell ECE in January of 2022 where he leads the Photonics and Quantum Electronics group.



From [2]. Surface-electrode ion trap device with integrated optical delivery, enabling integrated high-fidelity multi-ion quantum logic. Ions are confined 50 µm above the surface metallization. Light addressing qubits is delivered via attached optical fiber arrays to multiple channels of silicon nitride waveguides on chip, and emitted to ions above the surface via beam-forming grating couplers emitting through openings in the electrode patterns.

Intercalation and Functionalization in 2D Materials

M. Wang, S. Reed-Lingenfelter, S. Xu, N. Williams, J. J. Cha

Materials Science & Engineering, Cornell University

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Abstract:

The large surface areas and interlayer gaps of 2D materials enable surface functionalization and intercalation as effective post-synthesis design knobs to tune the properties of 2D materials using ions, atoms, and organic molecules. For complete engineering control, detailed understanding of the interactions between the 2D materials and the molecules adsorbed on 2D materials surface or between the 2D materials and the intercalants is necessary.

I will first discuss surface functionalization to tune the electrical properties of 2D materials. We developed an experimental approach to quantitatively measure the doping powers of organic electron donors (OEDs) to monolayer MoS2. Using novel and previously studied OEDs, we demonstrate experimentally that the measured doping power is a sensitive function of molecule's reduction potential, size, surface coverage, and orientation to 2D materials [1, 2].

I will then discuss electrochemical intercalation into 2D materials to induce novel phases that were previously undetected and to study heterointerface effects on the intercalation induced phase transition [3, 4]. We discover a new structural phase in Td-WTe2 with lithium intercalation and this new phase is semiconducting even though the initial WTe2 is semimetallic and lithium ions donate electrons to WTe2. In the lithium intercalation-induced phase transition from the 2H to 1T' phase of MoS2, we show that the nucleation of the 1T' phase proceeds via heterogeneous nucleation where the nature of heterointerface dictates the thermodynamics of the phase transition.

References:

[1] Advanced Electronic Materials 7, 2000873 (2021).

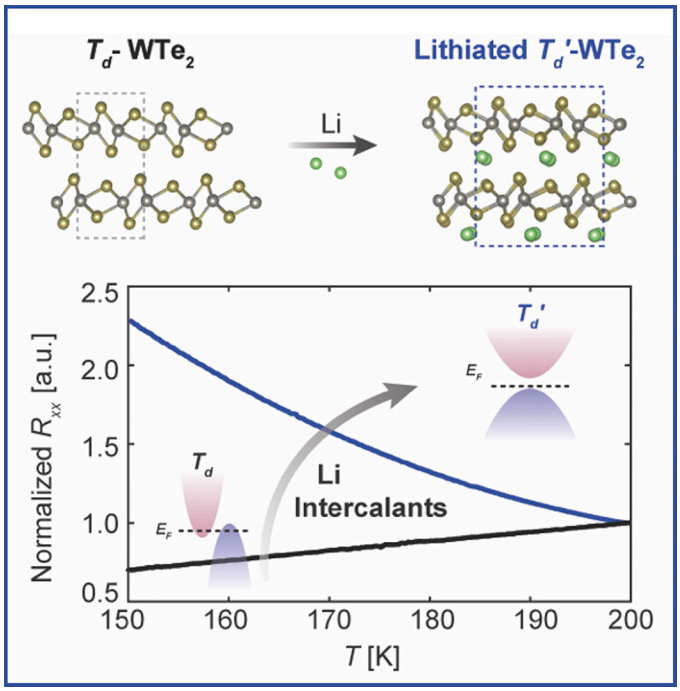
[2] Nano Letters 22, p.4501 (2022).

[3] ACS App Materials & Interfaces 13, p.10603-10611 (2021).

[4] Advanced Materials 34, 2200861 (2022).

Biography:

Judy J. Cha is Professor in the Department of Materials Science and Engineering at Cornell University. She received her Ph.D. in Applied Physics from Cornell University in 2009 and did her post-doc research at Stanford University in the Department of Materials Science and Engineering. Before joining Cornell in 2022, she was a faculty member in the Dept. of Mechanical Engineering and Materials Science at Yale University. She is a recipient of the SRC Young Faculty Award (2021), the Gordon & Betty Moore EPiQS Synthesis Investigator Award (2019), the NSF CAREER (2018), the Canadian Institute for Advanced Research (CIFAR) Azrieli Global Scholar for quantum materials (2017), the Yale Arthur Greer Memorial Prize (2016), and the IBM Faculty Award (2014).



Lithium intercalation into the gaps between layers of WTe2 converts semimetallic WTe2 to semiconducting Li-WTe2, demonstrating intercalation as a powerful tuning knob to control properties of layered materials, post synthesis.

POSTER INFORMATION

CENTER POSTER INFORMATION

Cornell Center for Materials Research

Author(s): Donna Howell, Director of Industry Outreach

Principal Investigator Prof. Frank Wise, CCMR Director

Affiliation(s): Office of the Vice President for Research and Innovation (OVPRI)

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The Biotechnology Resource Center

Author(s): James VanEe

Principal Investigator: Matt DeLisa

Affiliation(s): Cornell Institute of Biotechnology

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Center for Technology Licensing at Cornell (CTL)

Author(s): Ryan Luebke

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CNF STAFF POSTER INFORMATION

CNF Processing Capabilities

Author(s): Chris Alpha and Mike Skvarla

Affiliation: Cornell NanoScale Science and Technology Facility

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Primary CNF Tools Covered: Miscellaneous Process Equipment

Electron Beam Lithography Capabilities

Author(s): Alan R. Bleier, John C. Treichler, Giovanni Sartorello, Roberto Panepucci

Affiliation: Cornell NanoScale Science and Technology Facility

Email: bleier@cnf.cornell.edu, ober@cnf.cornell.edu

Primary CNF Tools Covered: JEOL 6300FS, JEOL 9500FSZ

Photolithography Tool Updates

Author(s): Garry Bordonaro

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Email: bordonaro@cnf.cornell.edu

Primary CNF Tools Covered: Photolithography Tool

Computing and CAD at CNF

Author(s): Dave Botsch, Karlis Musa

Affiliation(s): Cornell NanoScale Science and Technology Facility

Email: computing@cnf.cornell.edu

Primary CNF Tools Covered: Linux HotDeskting w CNF Thin, Linux conversion servers Korat and Minx, Simulation Software, CAD Software, Image/Data Analysis Software, CAD Rm Computing Lab, Windows CAD Workstations, Virtual CAD Room Remote Windows Desktops, Large format poster printer, Remote video tool trainings, Pseudopotential Vault, OpenAFS file system, 3D CAD Computing Server, AWS Conversion Cloud, Computation/Simulation Cluster

CNF Etching Highlights

Author(s): Jeremy Clark, Vince Ge-nova

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Primary CNF Tools Covered: Unaxis 770, Oxford Cobra, PlasmaTherm DSE, Oxford 10 ICP, PlasmaTherm770

High Frequency Test Lab

Author(s): Gianluca Fabi, Lei Li, James C. M. Hwang

Principal Investigator: James C. M. Hwang

Affiliation(s): Cornell University, Material Science and Engineering

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CNF Staff Over the Years

Author(s): Melanie-Claire Mallison, Editor

Affiliation: Cornell NanoScale Science and Technology Facility

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Primary CNF Tools Used: MCM's MAC!

Photolithography and New Capabilities Direct Write Laser

Author(s): Roberto Panepucci, Garry Bordonaro, Michael Skvarla, Chris Alpha, John C. Treichler

Affiliation: Cornell NanoScale Science and Technology Facility

Email addresses: rrp23@cornell.edu

Primary CNF Tools Covered: Heidelberg DWL66

Education and Outreach at the Cornell NanoScale Facility

Authors: Tom Pennell, Lynn Rathbun, Christopher Ober, Ron Olson

Affiliation: Cornell NanoScale Science and Technology Facility

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Thin Film Deposition Capabilities at CNF

Authors: Jeremy Clark, Tom Pennell, Aaron Windsor, Christopher Ober, Ron Olson

Affiliation: Cornell NanoScale Science and Technology Facility

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Primary CNF Tools Covered: Oxford PECVD, PlasmaTherm HDP-CVD, AJA Sputter Tools, OEM Endeavor M1, Angstrom Evaporator, CHA Evaporators

Metrology and Packaging Capabilities

Authors: George (Mac) McMurdy, Xinwei Wu

Affiliation: Cornell NanoScale Science and Technology Facility

Email: mcmurdy@cnf.cornell.edu, wu@cnf.cornell.edu

Primary CNF Tools Covered: Optical Microscopes, Interfer-ometers, Optical Profilometer, Ellipsometers, Scanning Electron Mi-croscope, Atomic Force Microscope, Energy-Dispersive X-ray Spectroscopy, X-ray Diffractometer, Wirebonder, Flip Chip Bonder

CNF USER POSTER INFORMATION & NUMBERS

1

Wang Poster Information

Cilia metasurfaces for electronically programmable microfluidic manipulation

CNF Project # 241616

Author(s): Wei Wang, Qingkun Liu, Ivan Tanasijevic, Michael F. Reynolds, Alejandro J. Cortese, Marc Z. Miskin, Michael C. Cao, David A. Muller, Alyosha C. Molnar, Eric Lauga, Paul L. McEuen & Itai Cohen

Principal Investigator: Itai Cohen

Affiliation(s): Laboratory of Atomic and Solid State Physics, Cornell University; Sibley School of Mechanical and Aerospace Engineering, Cornell University; Department of Applied Mathematics and Theoretical Physics, University of Cambridge; Department of Electrical and Systems Engineering, University of Pennsylvania

Email addresses: ww459@cornell.edu; itai.cohen@cornell.edu

Primary CNF Tools Used: ALD, sputter, evaporator, contact aligner, mask writer, Oxford etchers

2021-2022 CNF Research Accomplishments Report, Pages 102-103

2

Zheng Poster Information

Ultrathin Ruthenium Electrochemical Microactuators

CNF Project # 900-00

Author(s): Zhangqi Zheng (1), Michael Reynolds (2), Jeremy Clark (3), Samantha Norris (1), Qingkun Liu (1), Nicholas Abbott (2), Itai Cohen (1)(4), Paul McEuen (1)(4)

Principal Investigator: Paul McEuen

Affiliation(s)

(1) Laboratory of Atomic and Solid State Physics, Cornell University

(2) Smith School of Chemical and Biomolecular Engineering, Cornell University

(3) Cornell Nanoscale Facility, Cornell University

(4) Kavli Institute at Cornell for Nanoscale Science, Cornell University

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Primary CNF Tools Used; Veeco Savannah ALD, AJA sputter deposition (1&2), Oxford PECVD, ABM contact aligner, Heidelberg mask writer - DWL2000, AJA ion mill, Oxford 80 etchers, Oxford 100 etcher, Xactic xenon difluoride etcher

3

Cestarollo Poster Information

Design and Fabrication of Integrated Magnetic Elastomer-Based Soft Actuator

CNF Project #286620

Author(s): Ludovico Cestarollo, Rodolfo Cantu, Shane Smolenski, Amal El-Ghazaly

Principal Investigator: Amal El-Ghazaly

Affiliation(s): Ludovico Cestarollo - Materials Science and Engineering, Cornell University; Rodolfo Cantu - Cornell University CNF REU Summer 2022; Shane Smolenski - Cornell University CCMR REU Summer 2021; Amal El-Ghazaly - Electrical and Computer Engineering, Cornell University

Email addresses: lc942@cornell.edu, ase63@cornell.edu

Primary CNF Tools Used: General photolithography, ABM Contact Aligner, Hamatech Wafer Processor Develop, PlasmaTherm 72 Reactive Ion Etcher, C&D SmartProP9000, DISCO Dicing Saw, P7 Profilometer, Heidelberg Mask Writer DWL 2000, Hamatech Mask Chrome Etch, AJA Ion Mill

2021-2022 CNF Research Accomplishments Report, pages 84-85

4

Liu Poster Information

Microscopic, continuum, compliant, and electronically configurable metamaterial robots

CNF Project # 2416-16

Author(s): Qingkun Liu, Wei Wang, Himani Simhmar, Jacob T. Pelster, Itay Griniasty, Jinsu Kim, Michael F. Reynolds, Michael C. Cao, David A. Muller, Alyssa B. Apsel, Nicholas L. Abbott, Hadas Kress-Gazit, Paul. L. McEuen, Itai Cohen

Principal Investigator: Itai Cohen

Affiliation(s): Department of Physics, Cornell University

Email addresses: ql59@cornell.edu, Itai.cohen@cornell.edu

Primary CNF Tools Used: DWL 2000 mask writer, ABM contact aligner, Arradiance ALD, Oxford 81, Oxford PECVD, Ion mill, AJA sputter

2021-2022 CNF Research Accomplishments Report, pages 102-103

5

Yu Poster Information

Patternable Mesoporous Thin Film Superconductors via Block Copolymer Self-Assembly: An Emergent Technology toward Quantum Metamaterials?

CNF Project #: 135605

Author(s): Fei Yu, Paxton Thedford, Ulrich Wiesner

Principal Investigator: Ulrich Wiesner

Affiliation(s): Department of Materials Science and Engineering, Cornell University

Email addresses: fy84@cornell.edu, ubw1@cornell.edu

Primary CNF Tools Used: Oxford 81 Etcher, ABM Contact Aligner

6

Kaefer Poster Information

Chemically Amplified Photoresists with Precise Molecular Structure

CNF Project #: 175709, Direct Patterning of Polymer Brushes by Electron-Beam Lithography

Author(s): Florian Kaefer, Christopher Kemper Ober

Principal Investigator: Christopher Kemper Ober

Affiliation(s): Cornell, Department of Material Science and Engineering

Email addresses: fhk28@cornell.edu, cko3@cornell.edu

Primary CNF Tools Used: JEOL 6300, ASML DUV stepper

2021-2022 CNF Research Accomplishments Report, pages 46-47

7

McCullian Poster Information

Quantifying NV-Center Spectral Diffusion by Symmetry

CNF Project #: 212612

Author(s): Brendan A. McCullian, Hil-Fung Harry Cheung, Huiyao Chen, Gregory D. Fuchs

Principal Investigator: Prof. Gregory Fuchs

Affiliation(s): School of Applied and Engineering Physics, Cornell University

Email addresses: bam327@cornell.edu, gdf9@cornell.edu

Primary CNF Tools Used: GCA 6300 DSW 5X g-line Wafer Stepper, Heidelberg Mask Writer-DWL2000, AJA Sputter Deposition, Westbond 7400A Ultrasonic Wire Bonder

2021-2022 CNF Research Accomplishments Report, pages 168-169

8

Mahalanabish Poster Information

Nanotopographical metasurfaces for FTIR based biosensing

CNF Project #: 247216

Author(s): Aditya Mahalanabish, Steven H Huang, Gennady Shvets

Principal Investigator: Gennady Shvets

Affiliation(s): Applied and Engineering Physics, Cornell University

Email addresses: am2952@cornell.edu, hh623@cornell.edu, gs656@cornell.edu

Primary CNF Tools Used: Oxford PECVD, JEOL 9500, CVC SC4500 Odd Hour Evaporator, PT 740

2021-2022 CNF Research Accomplishments Report, pages 22-23

9

Xie Poster Information

Magnetic Field Sensor Based on Spin-Hall Nano-oscillators

CNF Project #: 209111

Author(s): Yanyou Xie, Hil Fung Harry Cheung and Gregory D. Fuchs

Principal Investigator: Prof. Gregory D. Fuchs

Affiliation(s): School of Applied & Engineering Physics, Cornell University

Email addresses: yx322@cornell.edu, hc663@cornell.edu, gdf9@cornell.edu

Primary CNF Tools Used: JEOL9500, MA6 Contact Aligner

2021-2022 CNF Research Accomplishments Report, pages 164-165

10

Zhang Poster Information

Investigation of palladium strains and actuation in gaseous environments

CNF Project # 273618

Author(s): Hanyu Alice Zhang

Principal Investigator: Nicholas Lawrence Abbott

Affiliation(s); Applied and Engineering Physics, Chemical and Biomolecular Engineering, Cornell

Email addresses; hz496@cornell.edu, nla34@cornell.edu

Primary CNF Tools Used: Heidelberg DWL2000 Mask Writer, ABM Contact Aligner, Oxford 81/82/100 Etchers, AJA Sputter Deposition Tool, AJA Ion Mill, Oxford PECVD, SC4500 Odd-Hour Evaporator, PT770 Etcher (Left Side), OEM, Leica CPD300 critical point dryer, DISCO Dicing Saw

2021-2022 CNF Research Accomplishments Report, pages 80-81

11

Chung Poster Information

Probing Nanoscale Magnetism in Fe5GeTe2 with Magneto-Thermal Microscopy

CNF Project #: 209111

Author(s): Clara Chung, Hongrui Zhang, Rui Chen, Gregory D Fuchs

Principal Investigator: Greg Fuchs

Affiliation(s): Dept of Physics, AEP (MSE UC Berkeley for collaborators)

Email addresses: ec893@cornell.edu, gdf9@cornell.edu

Primary CNF Tools Used: GCA 6300 DSW 5X g-line Wafer Stepper, AJA Orion Sputtering Systems, DISCO Dicing Saw, Heidelberg Mask Writer - DWL2000, Westbond 7400A Ultrasonic Wire Bonder

2021-2022 CNF Research Accomplishments Report, pages 162-163

12

Liu Poster Information

Microfluidic modeling of photosynthetic microorganisms for a sustainable future

CNF Project #: 2262-13

Author(s): Fangchen Liu, Larissa Gaul, Mohammad Yazdani, Daniel Vitenson, B.A. Ahner, and M.Wu

Principal Investigator: Dr. Mingming Wu

Affiliation(s): Department of Biological and Environmental Engineering

Email addresses: fl373@cornell.edu, mw272@cornell.edu

Primary CNF Tools Used: Heidelberg Mask Writer-DWL2000, ABM Contact Aligner, P10 Profilometer, MVD100, Versalaser Engraver/Cutter Tool

2021-2022 CNF Research Accomplishments Report, pages 20-21

13

Suh Poster Information

Development of a 3D Microfluidic Platform for Dynamic Compression of Tumor Spheroids

CNF Project #: 206811

Author(s): Young Joon Suh, Mrinal Pandey, Tao Luo, and Mingming Wu

Principal Investigator: Mingming Wu

Affiliation(s): Department of Biological and Environmental Engineering, Cornell University

Email addresses: ys668@cornell.edu, mw272@cornell.edu

Primary CNF Tools Used: ABM Contact Aligner, MVD100, SUEX Laminator, YES EcoClean Asher, Unaxis 77, Plasma-Therm Deep Si Etcher, Oxford 81 Etcher, Oxford PECVD, YES Polyimide Oven

2021-2022 CNF Research Accomplishments Report, pages 16-17

14

Thomas Poster Information

Mesenchymal Stromal Cells Transfer Functional Mitochondria to Chondrocytes in Microvesicles

CNF Project # 286420

Author(s) Matthew A. Thomas, Megan J. Fahey, Brenna R. Pugliese, Rebecca M. Irwin, Marc A. Antonyak, Michelle L. Delco

Principal Investigator: Dr. Michelle Delco

Affiliation(s): Cornell University College of Veterinary Medicine, Department of Clinical Sciences

Email addresses: mt826@cornell.edu, mld12@cornell.edu

Primary CNF Tools Used: Malvern Nano ZS Zetasizer, NanoSight NS300

2021-2022 CNF Research Accomplishments Report, pages 34-35

15

Crowley Poster Information

Microfluidic purification of photo-biotinylated DNA toward image-correlated genomics research at sub-femtoliter resolution

CNF Project # 142506

Author(s): Jack C. Crowley1, Thomas C. Roberts2, Eryka Kairo3, Mitchell V. Woodhouse4, Abdullah Ozer4, John T. Lis4, Claudia Fischbach-Teschl3, Warren R. Zipfel1,2,3

Principal Investigator: Warren Zipfel

Affiliation(s): 1School of Applied & Engineering Physics, 2Smith School of Chemical and Biomolecular Engineering, Meinig School of Biomedical Engineering, 4Department of Molecular Biology and Genetics; Cornell University, Ithaca, NY, USA.

Email addresses: jcc453@cornell.edu, wrz2@cornell.edu

Primary CNF Tools Used: Class II photoresist room, Heidelberg mask writer, ABM contact aligner

16

Smart Poster Information

Magnetically Controlled Diffractive Robotics

CNF Project # 900-00

Author(s) Conrad Smart, Zexi Liang, Melody Lim

Principal Investigator: Paul McEuen

Affiliation(s) Laboratory of Atomic and Solid State Physics

Email addresses: cs2239@cornell.edu, zl467@cornell.edu, mxl3@cornell.edu, plm23@cornell.edu

Primary CNF Tools Used: JEOL, ASML, SEM, AFM, etc.

2021-2022 CNF Research Accomplishments Report, pages 98-99

17

Mathur Poster Information

Spin Control and Spectroscopy of Defects in Hexagonal Boron Nitride

CNF Project #: 212612

Author(s): Nikhil Mathur, Arunabh Mukherjee, Xingyu Gao, Jialun Luo, Brendan A. McCullian, Tongcang Li, A. Nick Vamivakas, Gregory D. Fuchs

Principal Investigator: Gregory D. Fuchs

Affiliation(s): Applied and Engineering Physics, Cornell University

Email addresses: nm648@cornell.edu, gdf9@cornell.edu

Primary CNF Tools Used: GCA 5x Stepper, AJA Sputter Deposition

18

Alfonso Poster Information

Super-resolution imaging of unusual metal-responsive transcriptional regulation mechanisms in bacteria

CNF Project #: 184409

Author(s): Felix S. Alfonso, Bing Fu, Wenyao Zhang, and Peng Chen

Principal Investigator: Peng Chen

Affiliation(s): Department of Chemistry and Chemical Biology

Email addresses: fsa33@cornell.edu and pc252@cornell.edu

Primary CNF Tools Used: Heidelberg Mask Writer DWL2000, SUSS MA6-BA6 Contact Aligner, Oxford Cobra ICP Etcher, Plasma-therm Deep Silicon Etcher, and P7 Profilometer.

2021-2022 CNF Research Accomplishments Report, pages 10-11

19

Luo Poster Information

Magneto-photoluminescence in Single GaN Quantum Emitters

CNF Project # 212612

Author(s): Jialun Luo [1], Yifei Geng [2], Len van Deurzen [3]

Principal Investigator(s): Gregory D. Fuchs [3], Farhan Rana [2], Debdeep Jena [4], Huili (Grace) Xing [4]

Affiliation(s): [1] Department of Physics, Cornell University; [2] School of Electrical and Computer Engineering, Cornell University; [3] School of Applied and Engineering Physics, Cornell University; [4] Department of Materials Science and Engineering, Cornell University

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Primary CNF Tools Used: AJA sputter tool; GCA 5X stepper; Heidelburg Mask Writer

2021-2022 CNF Research Accomplishments Report, pages 166-167

20

Reynolds Poster Information

In-air Electrochemical Polymer Microactuators for Mi-crorobotics

CNF Project #: 273618

Author(s): Michael F. Reynolds (1), Nanqi Bao (1), Qingkun Liu (2), Alejandro J. Cortese (2,3), Hanyu Zhang (1), Daniel M. Palmer (3), Shahaboddin Ghajari (3), Cindy Qiu (1), Itai Cohen (2, 4), Alyosha C. Molnar (3), Paul L. McEuen (2, 4), Nicholas L. Abbott (1)

Principal Investigator: Nicholas L. Abbott

Affiliation(s): 1. Chemical and Biomolecular Engineering 2. LASSP, 3. Department of Electrical and Computer Engineering, 4. Kavli Institute for Nanoscale Science, Cornell University

Email addresses: mfr74@cornell.edu, nla34@cornell.edu

Primary CNF Tools Used: AJA Ion Mill, AJA Sputter Deposition, ABM Contact Aligner, Oxford 80 etchers, Xactic Xenon Difluoride Etcher

21

Kim Poster Information

Growth and fabrication of N-polar high-electron-mobility transistors

CNF Project # 280019

Author(s): EK Kim, Zexuan Zhang, Jimy Encomendero, Kazuki Nomoto

Principal Investigator: Grace Xing, Debdeep Jena

Affiliation(s): Electrical and Computer Engineering Department, Cornell University

Email addresses: ek543@cornell.edu, zz523@cornell.edu, jje64@cornell.edu, kn383@cornell.edu, djena@cornell.edu, grace.xing@cornell.edu

Primary CNF Tools Used: i-line AS200 Stepper, PT770 etcher, Glen1000, JEOL6300, Oxford81, FlexAL ALD, odd-hour metal evaporator, AJA sputtering tools

22

Choi Poster Information

Electric field sensing using inter- and intra-layer excitons in WSe2

CNF project number: 212612

Authors: Jaehong Choi

Principal Investigator: Greg Fuchs

Affiliation: Applied and Engineering Physics, Cornell University

Email address: jc3452@cornell.edu, gdf9@cornell.edu

Primary CNF Tools Used: GCA 5X g-line stepper, SC4500 Odd-Hour Evaporator, Anatech Resist Strip

2021-2022 CNF Research Accomplishments Report, pages 124-125

23

Guo Poster Information

Developing a single spin microscope for nanoscale magnetic imaging

CNF Project #: 212612

Author(s): Qiaochu Guo, Anthony D'Addario, Yang Cheng, Jeremy Kline, Isaiah Gray, Hil Fung Harry Cheung, Fengyuan Yang, Katja Nowack, Gregory D. Fuchs

Principal Investigator: Katja Nowack, Gregory D. Fuchs

Affiliation(s): Cornell AEP

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Primary CNF Tools Used: photolithography

24

Bosch Poster Information

Tunable Semiconductor Metasurfaces for Active Lensing

CNF Project #: 297921

Author(s): Melissa Bosch, Maxim R. Shcherbakov, Kanghee Won, Hong-Seok Lee, Young Kim, Gennady Shvets

Principal Investigator: Gennady Shvets

Affiliation(s): Cornell University, School of Applied and Engineering Physics (AEP)

Email addresses: mb2583@cornell.edu, gshvets@cornell.edu

Primary CNF Tools Used: JEOL 9500, Zeiss Ultra SEM, Oxford Cobra Etcher, Oxford 100 Etcher, Oxford PECVD, Woollam RC2 Ellipsometer

2021-2022 CNF Research Accomplishments Report, pages 146-147

25

Liang & Lim Poster Information

Self-Assembling Digital Magnetic Polymer

CNF Project # 296421

Author(s): Zexi Liang, Melody Xuan Lim

Principal Investigator: Itai Cohen, Paul McEuen

Affiliation(s): LASSP

Email addresses: zl467@cornell.edu, mxl3@cornell.edu, ic64@cornell.edu, plm23@cornell.edu

Primary CNF Tools Used: ASML stepper, JEOL 6300, Oxford PECVD, AJA sputter, ebeam evaporator

2021-2022 CNF Research Accomplishments Report, pages 98-99, 110-111

26

Zhao Poster Information

X-band and Ku-band epitaxial AlN-on-SiC FBARs

Authors: Wenwen Zhao, Mohammad Javad Asadi, Lei Li, Reet Chaudhuri, Kazuki Nomoto, Huili Grace Xing, James Hwang and Debdeep Jena

CNF project number: 280119

CNF principal investigator: Debdeep Jena, Huili Xing

Department and institution: Applied and Engineering Physics, Cornell University

Contact email: wz344@cornell.edu, djena@cornell.edu

Primary CNF tools used: ABM/SUSS MA6 contact aligner, E-beam evaporator, AJA sputter, AJA ion mill, Arradiance ALD, SEM, AFM, PT770 etcher, Oxford Cobra ICP etcher, Electroplating hood

27

Struzyk Poster Information

Biodegradable Phosphate Sensor for Agricultural Use

Author(s): Ariel A. Struzyk, Elizabeth V. Schell, and Mark G. Allen

NNCI REU Principal Investigator: Mark G. Allen

NNCI REU Affiliation(s): The Singh Center REU Program:
Singh Center for Nanotechnology, University of Pennsylvania

Elizabeth and Professor Allen's affiliation:
Electrical and Systems Engineering, University of Pennsylvania

Ariel's affiliation: College of Engineering, Cornell University

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(Not Eligible for CNF User Poster Awards)

28

Chen, Yulan Poster Information

Exploring Magnetic Nanochain Anisotropy for Flexible Composite Micro-Actuators

CNF Project # 286720

Author(s): Yulan Chen; Amal El-Ghazaly

Principal Investigator: Amal El-Ghazaly

Affiliation(s): Materials Science and Engineering, Cornell University

Email addresses: yc2555@cornell.edu; ase63@cornell.edu

Primary CNF Tools Used: AFM - Veeco Icon; Zeiss Ultra SEM

29

Tan Poster Information

Electroluminescence Study of Buried Tunnel Junction Laser Diode

CNF Project #: 280119

Author(s): Justin Tan, Len van Deurzen, Vladimir Protasenko, Grace Xing, Debdeep Jena

Principal Investigator: Debdeep Jena

Affiliation(s): ECE, AEP, MSZE, Cornell University

Email addresses: jt779, dj326

Primary CNF Tools Used: photolithography

30

D'Addario Poster Information

Dynamic strain measurements in thin-film bulk acous-tic resonators with stroboscopic x-ray diffraction microscopy

CNF Project #212612

Author(s): Anthony D'Addario, Johnathan Kuan, Huiyao Chen, Noah Opando, Ozan Erturk, Tao Zhou, Sunil Bhave, Martin Holt, Gregory Fuchs

Principal Investigator: Gregory Fuchs

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Primary CNF Tools Used: GCA 6300 DSW 5X g-line Wafer Stepper, Heidelberg Mask Writer - DWL2000, AJA Sputter Deposition, YES Asher, Westbond 7400A Ultrasonic Wire Bonder

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Maiti Poster Information

Liquid crystal-based sensors for guiding chemotaxis in microrobots

CNF Project #: 287420

Author(s): Soumita Maiti, Sangchul Roh, Parag Chaudhari, Milad Taghavi Nezam Abad, Alyssa B. Apsel, Itai Cohen, Nicholas L. Abbott

Principal Investigator: Nicholas L. Abbott

Affiliation(s): Robert Frederick Smith School of Chemical and Biomolecular Engineering, Electrical and Computer Engineering, Laboratory of Atomic and Solid-State Physics, Cornell University

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Primary CNF Tools Used: Heidelberg Mask Writer, ABM contact aligner, Dicing Saw - DISCO

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Huang Poster Information

Visualization of solvent-induced organization of polypeptide rod brushes via fluorescent probes and molecular simulations

CNF Project #: 1757-09

Author(s); Yuming (Robin) Huang1, Luis Adrian Padilla Salas2, Su-Mi Hur2, Christopher K. Ober1

Principal Investigator: Christopher K. Ober1

Affiliation(s): 1 Department of Materials Science and Engineering, Cornell University; 2 School of Polymer Science and Engineering, Chonnam National University

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Primary CNF Tools Used: JEOL 9500, AFM - Veeco Icon, Zeiss Ultra SEM, Oxford 81

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Pelster Poster Information

Strong Bulk Electrochemical Actuators for Micro-Scale Applications

CNF Project #: 2416-16

Authors: Jacob Pelster, Qingkun Liu, Wei Wang, Ariana Ray, Michael Reynolds, Zexi Liang, Nicholas Abbott, David Muller, Itai Cohen

Principal Investigator: Itai Cohen

Affiliations: Mechanical Engineering, Physics; Cornell University

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Primary Tools: ABM contact aligner, AJA Sputter, Endeavor, Oxford ALD, Oxford PECVD, Odd Hour Evaporator, Dicing Saw, Oxford 81, Pt740

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Kuan Poster Information

Nuclear Spin Dephasing in NV centers under Optical Illumination

CNF Project #: 212612

Author(s): Johnathan Kuan, Anthony D'Addario

Principal Investigator: Gregory Fuchs

Affiliation(s): Department of Physics, Applied and Engineering Physics, Cornell University

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Primary CNF Tools Used: GCA 5x g-line stepper, AJA sputter deposition

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Mokhtare Poster Information

Selective single-beam acoustic tweezers for cell ma-nipulation

CNF Project # Developing Microfluidic Systems for Cell Sorting and Immunoassay Purposes

Author(s): Amir Mokhtare, Alireza Abbaspourrad

Principal Investigator: Alireza Abbaspourrad

Affiliation(s): College of Agriculture and life Sciences, Cornell University

Email addresses: am2964@cornell.edu, ali-reza@cornell.edu

Primary CNF Tools Used: DWL2000, Odd evaporator, PT740

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VanderBurgh Poster Information

Scalable continuous-flow electroporation platform en-abling T cell transfection for cellular therapy manufacturing

CNF Project #290020

Author(s) Jacob VanderBurgh, Thomas Corso, Stephen Levy, Harold Craighead

Principal Investigator: Harold Craighead

Affiliation(s): CyteQuest

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Primary CNF Tools Used: Odd hour evaporator

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Jadhav Poster Information

HZO-based FerroNEMS MAC for In-Memory Computing

CNF Project #: 112103

Author(s): Shubham Jadhav, Ved Gund, Amit Lal

Principal Investigator: Amit Lal

Affiliation(s): School of Electrical and Computer Engineering, Cornell University

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Primary CNF Tools Used: SUSS MA-6 contact aligner, CVC SC-4500 Odd-hour evaporator, Zeiss SEM, Arradiance ALD, AJA sputter deposition Primaxx Vapour HF Etcher, Xactix Xenon Difluoride Etcher, AJA ion mill, P7 Profilometer, Zygo Optical Profilometer, Flexus Film Stress Measurement

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Norris Poster Information

Optically Powered Microscopic Bubble Rockets

CNF Project # 900-00

Author(s) Samantha Norris, Michael Reynolds, Alejandro Cortese, Paul McEuen

Principal Investigator: Paul McEuen

Affiliation(s): Cornell Physics

Email addresses: sn588@cornell.edu, mfr74@cornell.edu, ajc383@cornell.edu, plm23@cornell.edu

Primary CNF Tools Used: Heidelberg 2000, ABM Contact aligner, Oxford etchers, Oxford PECVD

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Ghajari Poster Information

Microsystems for Autonomous Sensors and Actuators

CNF Project #: 265818

Author(s): Shahaboddin Ghajari, Sunwoo Lee, Michael Reynolds, Daniel Palmer, Samantha Norris, Paul McEuen, Alyosha Molnar

Principal Investigator: Alyosha Molnar, Paul McEuen

Affiliation(s): Cornell, ECE

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Primary CNF Tools Used: ABM, Gamma Automatic Tool, YES Vapor Prime Oven, Oxford 80 / 100

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Sun Poster Information

Towards ultra-resolution mechanical detection of elec-tron magnetic resonance

CNF Project # 863-00

Author(s): Peter Sun

Principal Investigator: John Marohn

Affiliation(s): Chemistry and Chemical Biology

Email addresses: hs859@cornell.edu, jam99@cornell.edu

Primary CNF Tools Used: JEOL 6300

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Lee Poster Information

Micro-scale Opto-electrically Transduced Electrodes for Electrophysiological Monitoring

CNF Project # 257817

Author(s): Sunwoo Lee, S.Ghajari, S.Sadeghi, H.Zahr, W.Guo, M.Maurer, A.Mok, A.Cortese, S.Norris, Y.Ji, P.L. McEuen, C.Xu, S.Jiang, J.Lammerding, A.Molnar

Principal Investigator: Alyosha Molnar

Affiliation(s): Electrical and Computer Engineering, Cornell University

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Primary CNF Tools Used: ABM Contact Aligner, Oxford 100 ICP Dielectric Etcher, Oxford 81/82 Etchers, Anatech Resist Strip, AJA Sputter Deposition, and PT770 Etcher - Right Side (III-V)

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Alvarez Poster Information

High thermal conductivity and ultrahigh thermal boundary conductance of homoepitaxial AlN thin films

CNF Project # 275819

Author(s): Gustavo Alvarez1, Ryan Page2, Renjiu Hu1, Huili Grace Xing2,3, Debdeep Jena2,3, and Zhiting Tian1,

Principal Investigator: Zhiting Tian

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Email addresses: gaa78@cornell.edu, zhiting@cornell.edu

Primary CNF Tools Used: SC4500 Odd-Hour Evaporator, P7 Profilometer

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Xu Poster Information

Coupling between Superconducting Resonator and other degrees of freedom

CNF Project #: 212612

Author(s): Qin Xu, Harry Cheung, Donley Cormode, Michael Chilcote, Ezekiel Johnston-Halperin and Gregory D. Fuchs

Principal Investigator: Gregory D. Fuchs

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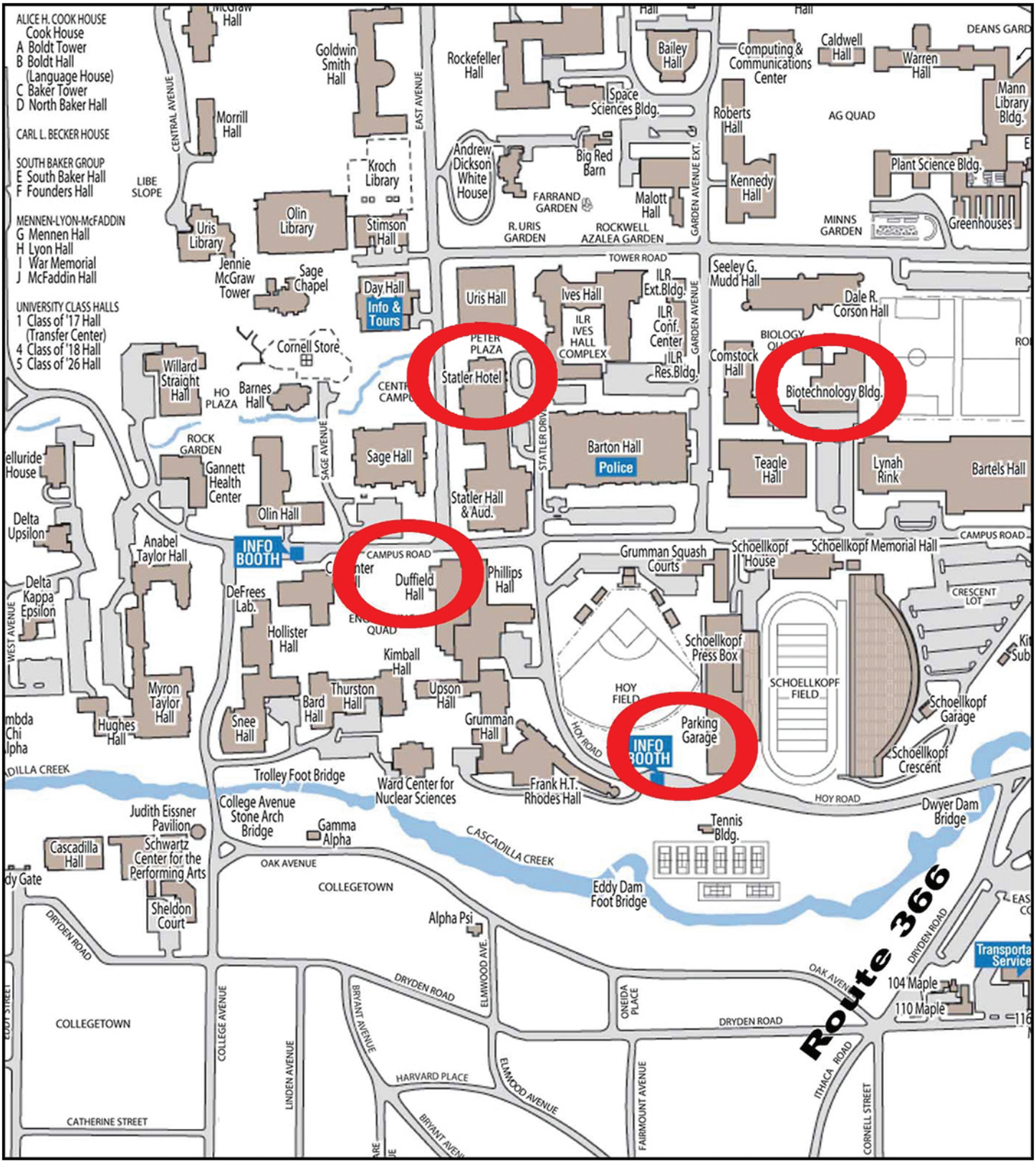
ALICE H. COOK HOUSE
Cook House
A Boldt Tower
B Boldt Hall
(Language House)
C Baker Tower
D North Baker Hall
CARL L. BECKER HOUSE
SOUTH BAKER GROUP
E South Baker Hall
F Founders Hall
MENNEN-LYON-McFADDIN
G Mennen Hall
H Lyon Hall
I War Memorial
J McFaddin Hall
UNIVERSITY CLASS HALLS
1 Class of '17 Hall
(Transfer Center)
4 Class of '18 Hall
5 Class of '26 Hall
McGraw Hall
Goldwin Smith Hall
Morrill Hall
Kroch Library
Uris Library
Olin Library
Stimson Hall
Jennie McGraw Tower
Sage Chapel
Day Hall
Info & Tours
Cornell Store
Willard Straight Hall
Barnes Hall
Rockefeller Hall
Space Sciences Bldg.
Bailey Hall
Computing & Communications Center
Caldwell Hall
Warren Hall
Mann Library Bldg.
Roberts Hall
AG QUAD
Andrew Dickson White House
Big Red Barn
FARRAND GARDEN
Malott Hall
Kennedy Hall
Plant Science Bldg.
R. URIS GARDEN
ROCKWELL AZALEA GARDEN
MINNS GARDEN
Greenhouses
TOWER ROAD
Uris Hall
Ives Hall
ILR Ext.Bldg.
ILR IVES HALL COMPLEX
ILR Conf. Center
ILR Res.Bldg.
Seeley G. Mudd Hall
Dale R. Corson Hall
Comstock Hall
Biotechnology Bldg.
PETER PLAZA
Statler Hotel
Barton Hall
Police
Teagle Hall
Lynah Rink
Bartels Hall
Statler Hall & Aud.
Sage Hall
Gannett Health Center
Olin Hall
INFO BOOTH
Anabel Taylor Hall
Delta Upsilon
Delta Kappa Epsilon
DeFrees Lab.
Duffield Hall
Phillips Hall
Hollister Hall
Kimball Hall
Myron Taylor Hall
Hughes Hall
Bard Hall
Thurston Hall
Upson Hall
Snee Hall
Grumman Hall
Grumman Squash Courts
Schoellkopf House
Schoellkopf Memorial Hall
CRESCENT LOT
Schoellkopf Press Box
HOY FIELD
SCHOELLKOPF FIELD
Schoellkopf Garage
Parking Garage
Schoellkopf Crescent
HOY ROAD
Trolley Foot Bridge
Ward Center for Nuclear Sciences
Frank H.T. Rhodes Hall
College Avenue Stone Arch Bridge
Judith Eissner Pavilion
Schwartz Center for the Performing Arts
Cascadilla Hall
Sheldon Court
Gamma Alpha
CASCADILLA CREEK
Tennis Bldg.
Dwyer Dam Bridge
Eddy Dam Foot Bridge
OAK AVENUE
COLLEGETOWN
Alpha Psi
DRYDEN ROAD
ELMWOOD AVE.
ONEIDA PLACE
Route 366
Transporta Service
104 Maple
110 Maple
COLLEGE AVENUE
LINDEN AVENUE
BRYANT AVENUE
HARVARD PLACE
ELMWOOD AVENUE
FAIRMOUNT AVENUE
ITHACA ROAD
CORNELL STREET
CATHERINE STREET
CENTRAL AVENUE
EAST AVENUE
GARDEN AVENUE
GARDEN AVENUE EXT.
STATLER DRIVE
SAGE AVENUE
WEST AVENUE
ROCK GARDEN
HO PLAZA
LIBE SLOPE
CAMPUS ROAD
DEANS GARD
CAMPUS ROAD