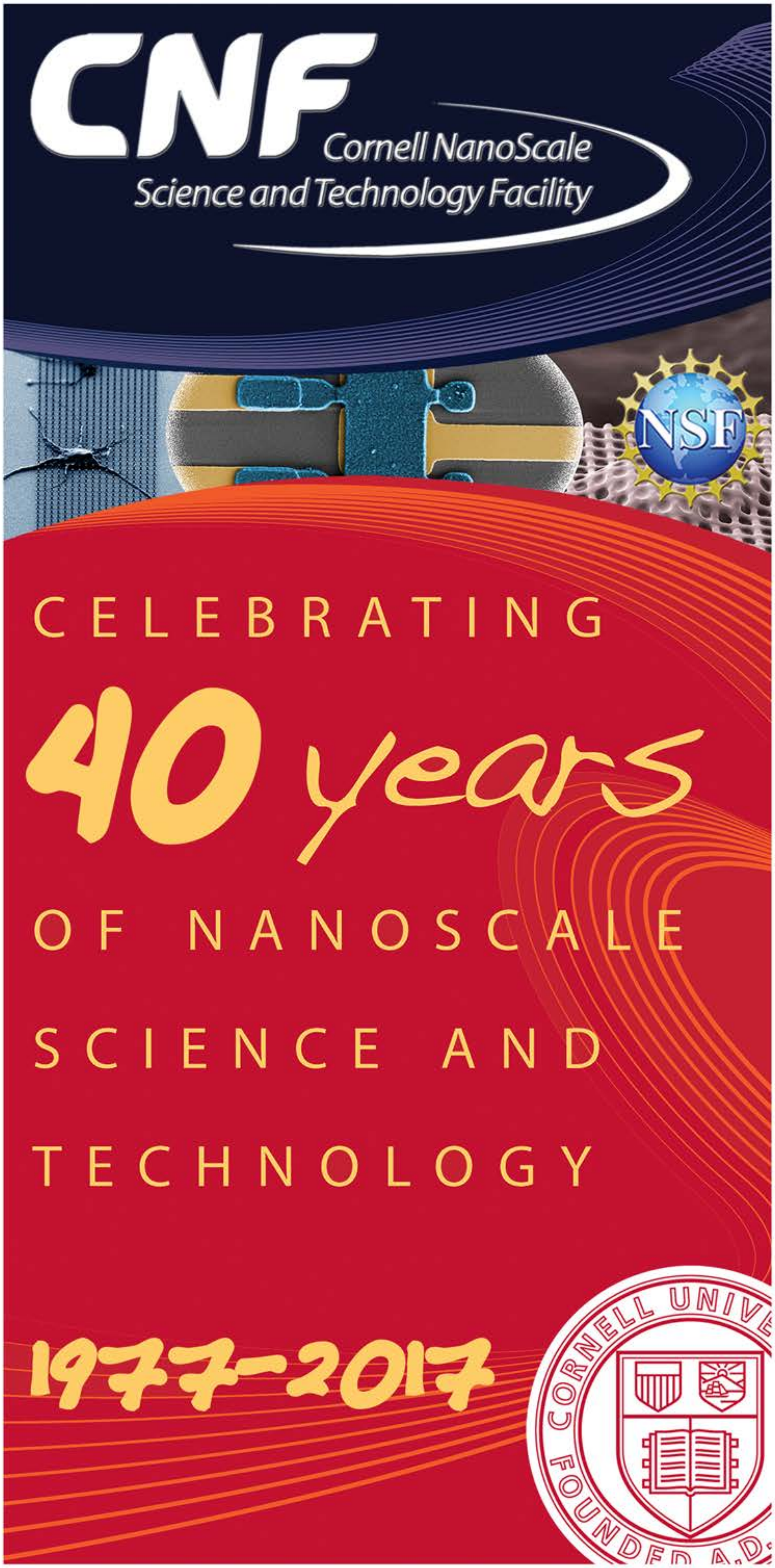

CNF 40th Anniversary Celebration & Annual Meeting

Thursday, September 14, 2017

Proceedings: Schedule, Sponsors, Letters of Congratulations, Speaker Abstracts, Posters

CNF Cornell NanoScale Science and Technology Facility

www.cnf.cornell.edu

CELEBRATING FORTY YEARS
of nanoscale science and technology
1977-2017

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Cornell NanoScale Science & Technology Facility

2017 Annual Meeting & 40th Anniversary Celebration

Thursday, September 14th, 2017

Cornell University, Ithaca, New York

Morning Session

8:00-8:45 a.m. Registration & Hot Breakfast Buffet (Foyer, Biotechnology Building)

Welcoming Remarks (G10 Biotechnology Building)

Session Chair, Christopher Ober

Plenary Speaker (G10 Biotechnology Building)

10:00-10:15, Break

Session Chair, Elizabeth Rhoades

11:30-1:00, Lunch (Statler Ballroom)

Afternoon Session

1:00-1:15, Lance R. Collins, Joseph Silbert Dean of Engineering, Professor Mechanical and Aerospace Engineering, Cornell University 15

Session Chair, Amrita Banerjee

1:15-1:40, Paul L. McEuen, John A. Newman Professor of Physical Science, Cornell University

Origami with 2D Materials 16

1:40-2:05, Robert D. Allen, Ph.D., Senior Manager, Materials Innovation Department, Distinguished Research Staff Member, Almaden Science & Technology, IBM Almaden Research Center

The Importance of a Nano-Fabrication Facility in Materials Innovation for Advanced Electronics, 17

2:05-2:30, Richard A Vaia, Technical Director, Air Force Research Laboratory's Materials and Manufacturing, Wright-Patterson Air Force Base

Flex-Hybrid Electronics: Revolutions from Health Monitoring to Aerospace 18

2:30-2:55, Break

Session Chair, Michael Skvarla

2:55-3:20, Narayan Sundararajan, Principal Engineer and Director, New Technology Group, Intel

IoT - For Sports, Entertainment and Social Impact 19

3:20-3:45, Jie Shan, Professor of Physics, The Pennsylvania State University

Photonics and optoelectronics of 2D semiconductors 20

3:45-4:10, Richard E. Howard, Winlab, Rutgers University

IoT Everywhere--Sounds Great, but What Are the Hidden Challenges?. 21

4:10-4:15, Break for panel set up

4:15-5:00, Kavli Panel Discussion

Session Chair, Donald Tennant

Presenters: George Malliaras, Elsa Reichmanis, Richard Howard, Richard Vaia and Michael Guillorn

5:00-5:30p, Break for poster session set up

5:30-7:30, Poster Session & Corporate Soiree (Duffield Hall Atrium)

User Poster Awards and the Nellie Yeh-Poh Lin Whetten Memorial Award will be given out at 7:00 p.m.

National Research and Resource Facility for Submicron Structures

Cornell University
424 Phillips Hall, Ithaca, New York 14853
607-256-2329

1977-81

NRRFSS

National Research and Resource Facility for Submicron Structures
Knight Laboratory, Cornell University
Ithaca, NY 14853 (607)256-2329

1981-1986

Office of the Director

NNF National Nanofabrication Facility at Cornell

1986-1993

14 September 2017

Professor Chis Ober, CNF Lester B. Knight Director
Don Tennant, CNF Operations Director
CNF, Duffield Hall, Cornell University
Ithaca, NY 14850

Dear Chris and Don,

I wish to offer my congratulations to you and the staff at CNF on this historic occasion of the 40th Anniversary of the Cornell NanoScale Facility. I am pleased to send my congratulations on sample copies of two original NRRFSS letterheads along with the letterhead for the transition to the National Nanofabrication Facility in 1986. Their dates of use are shown near the upper right margin.

You are the greatly enhanced continuation of the original National Research and Resource Facility for Submicron Structures, which has grown and matured to become the model for national and regional user facilities for nanoscale science and engineering around the world.

You are the embodiment of Cornell's successful leadership in nanotechnology, which preceded President Clinton's National Initiative in Nanotechnology 2001 by more than two decades. At Cornell, CNF has helped to create and support additional new initiatives in nano-science and technology. Furthermore, the management and staff of CNF have developed an enjoyable workplace environment that is second to none in professionalism and accomplishment through some very difficult times. Congratulations!

Sincerely,

Edward D. Wolf

Edward D. Wolf, Ph.D.
Professor Emeritus, School of Electrical and Computer Engineering, Cornell University
Director, National Research and Resource Facility for Submicron Structures, NRRFSS 1978-1986
Director, National Nanofabrication Facility, NNF 1986-1988
Home address: 380 Savage Farm Drive, Ithaca, NY14850
Email edw@twcny.rr.com

Cornell University
Knight Laboratory
Ithaca, NY 14853-5403
607/255-2329

Cornell University

Office of the Vice Provost
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Emmanuel P. Giannelis
Vice Provost for Research
Vice President for Technology Transfer, Intellectual Property and Research Policy
Walter R. Read Professor of Engineering
222 Day Hall
Ithaca, New York 14853-2801
t. 607.255.7200
f. 607.255.9030
epg2@cornell.edu

September 14, 2017

Chris Ober
Cornell NanoScale Science and Technology Facility
250 Duffield Hall
Cornell University
Ithaca, NY 14853

Dear Chris:

Congratulations to you and the Cornell NanoScale Science and Technology Facility community as you celebrate your 40th year anniversary! CNF has much to commemorate—40 years of pioneering research, far-reaching technology transfer, impressive outreach, a dynamic collaborative environment that also incorporates students, and overall outstanding service to the field of nanoscience and nanotechnology as well as to the public. Founded in 197l and supported by the National Science Foundation, CNF was the first of its kind, and the center has garnered many distinctions.

CNF's cutting-edge research facility is known, among others, as the place where the gene gun—the tool that revolutionized gene material transfer—was fabricated. CNF researchers have continued the pursuit of innovative technologies—for example, building model systems for determining how cancers metastasize; creating a high-density, fast, cheap, nonvolatile universal computer memory that doesn't wear out; and making origami-inspired micromachines.

From the community of CNF, startup companies such as Kionix, acquired by Rohm, and BinOptics, now MACOM, brought CNF technologies to the public though commercialization—advancing economic development in New York State. Now, CNF boasts 17 new startups, based on work done at the center in the last decade.

I applaud CNF, a collaborative community where engineers, life scientists, and physical scientists from Cornell and around the globe work together to deliver technologies, benefiting all aspects of life, and I convey my best wishes for CNF's 40th anniversary celebration.

Sincerely,

EP Gn

Emmanuel P. Giannelis
Vice Provost for Research
Vice President for Technology Transfer, Intellectual Property, and Research Policy

Cornell University

Martha E. Pollack
President

September 14, 2017

Christopher K. Ober
Lester B. Knight Director
Cornell NanoScale Science and Technology Facility
250 Duffield Hall
Cornell University
Ithaca, NY 14853

Dear Professor Ober:

As you and your colleagues gather at Cornell today to celebrate the 40th year of the Cornell NanoScale Science and Technology Facility, I am pleased to send my hearty congratulations on all CNF has achieved since its founding in 1977, and to offer my encouragement and good wishes as you plan for the facility's future role in nanoscience.

The very first National Science Foundation (NSF)-supported national user facility for nanoscale research, CNF has been a home for breakthrough science over the past four decades, and it remains the only New York State national user facility in NSF's National Nanotechnology Coordinated Infrastructure.

Not only does CNF provide engineers and scientists with world-class technical capabilities in a dynamic environment where students, scientists and industrial engineers can collaborate, but it also makes possible the pursuit of technologies across a wide spectrum of potential applications, from a "universal" computer memory, to artificial retinal implants, to origami-inspired micro-machines, among many others. In addition, CNF has an impressive record of helping to launch start-ups and commercial technologies based on nanoscience.

I had the privilege of touring CNF in late July and was very impressed by the sophistication of the facility and the expertise and dedication of the CNF staff. Here's to a productive conference and a bright future for nanoscience at Cornell.

Sincerely,

Martha E. Pollack

Martha E. Pollack

300 Day Hall Ithaca, NY 14853-2801 **Telephone:** (607) 255-5201 **Fax:** (607) 255-9924 **E-mail:** president@cornell.edu

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September 7, 2017

Cornell NanoScale Science and Technology Facility
Cornell University
Ithaca, NY 14850

To my Friends at Cornell:

On behalf of the State of New York, and the 125th Assembly District, I would like to offer my congratulations to you on this very significant anniversary - your facility has been in operation for 40 years!

The Cornell NanoScale and Technology Facility has provided a dynamic, state-of-the-art environment that allows students, scientists and industrial engineers to interact as they pursue advanced technologies that affect future health care options and research techniques, among numerous other applications. The facility has become a home for breakthrough science – the place where advances are born and nurtured.

Thank you for giving users from academia, industry and government laboratories the opportunity to learn and use the tools available in your facility. The research that they do advances the scientific community and will impact research for years to come.

Sincerely,

Barbara S. Lifton

Barbara Lifton
Member of Assembly
125th District

BSL/cme

ALBANY OFFICE: Room 555, Legislative Office Building, Albany, New York 12248 • 518-455-5444, FAX: 518-455-4640
DISTRICT OFFICE: 106 East Court Street, Ithaca, New York 14850 • 607-277-8030
EMAIL: liftonb@assembly.state.ny.us

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ANDREW M. CUOMO
GOVERNOR

September 14, 2017

Cornell University
Cornell NanoScale Science
and Technology Facility
250 Duffield Hall
343 Campus Road
Ithaca, NY 14853

Dear Friends:

It is a pleasure to send greetings to everyone gathered for the 40^{th} Anniversary Celebration and Annual Meeting of the Cornell NanoScale Facility.

Since 1977, the Cornell NanoScale Facility has been a home for breakthrough science, being the very first National Science Foundation-supported national user facility for nanoscale research. It remains a testament to the vision and determination of many individuals who all share a part in this anniversary celebration, including innovative scientists and engineers who believe in the power of nanotechnology in the 21^{st} century.

Today, you have assembled wonderful guest speakers and presentations to mark this four-decade milestone. On behalf of all New Yorkers, I congratulate Christopher Ober, Director of CNF, the Executive Committee, speakers, sponsors, and participants, as well as the leadership of Cornell University on 40 successful years in nanofabrication and much continued success ahead.

With warmest regards and best wishes for an enjoyable and productive day.

Sincerely,

ANDREW M. CUOMO

August 17, 2017

Professor Christopher K. Ober
Lester B Knight Director, CNF
Cornell University
Ithaca, NY

Dear Chris,

It is my pleasure to congratulate Cornell University and the Cornell NanoScale Science and Technology Facility (CNF) on the 40th anniversary of its long and distinguished service as a national user facility in nanotechnology. I was honored to speak in 2007 on the 30th anniversary of CNF, reflecting on its history as the first and continuing national user facility under support by the National Science Foundation. Today, CNF continues its important service to researchers and educators as a participating site in the NSF-supported National Nanotechnology Coordinated Infrastructure (NNCI).

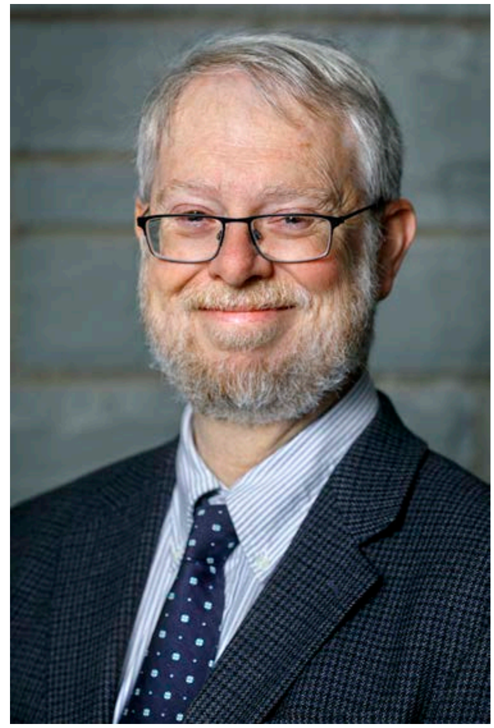
CNF has helped to catalyze new discoveries in nanoscale science and engineering and to stimulate technological innovation by providing researchers with access to leading-edge fabrication and characterization tools, instrumentation, and expertise. CNF has also enabled exceptional educational and training opportunities for students as users of its facilities. There are users of the CNF everywhere who speak with fondness of the research that was enabled and of the education that was received through its openness to creative ideas and individuals. The National Science Foundation is very proud to have played a role in its continued success.

Sincerely,

Lawrence S. Goldberg

Senior Engineering Advisor
National Science Foundation

The Cornell Nanoscale Facility: Celebrating 40 Years of Excellence



Christopher Kemper Ober

Lester B. Knight Director

Cornell NanoScale Science & Technology Facility (CNF)

250 Duffield Hall
343 Campus Road
Ithaca, NY 14853-2700
Ph: (607) 255-8417
Email: christopher.ober@cornell.edu
http://www.cnf.cornell.edu/cnf_2017am.html

Abstract:

Welcome to the Cornell Nanoscale Facility's 40th Anniversary meeting. We have an excellent program lined up with speakers covering topics that will provide insight into the future directions of nanoscience and point to new directions for CNF to pursue. From its founding in 1977 to today, CNF has grown from a small facility and a few staff to one of international prominence, housed in a 16,000 ft^2 cleanroom with state-of-the-art equipment covering most aspects of semiconductor and nanoscale processing. Since it inception it has been home for great scientific and technical discoveries. Recent examples include the formation of Kionix, responsible for accelerometers used in devices such as smart phones using MEMS technology developed at CNF. Another example is Pacific Biosciences whose products enable DNA sequencing using nanoscale optical methods, developed from science invented at CNF. CNF is pioneering new research directions related to the Internet of Things (IoT), biomedical science (including brain and cancer initiatives), nanophotonics and 2D materials (in support of the recent discovery of new materials within the Materials Innovation Platform award to Cornell). We expect that these new directions, new capabilities, creative users and our able staff will take us forward to our half century and beyond. See you then.

Biographical Sketch:

Christopher Ober is the Francis Bard Professor of Materials Engineering at Cornell University. He received his B.Sc. in Honours Chemistry (Co-op) from the University of Waterloo, Ontario, Canada in 1978 and his Ph.D. in Polymer Science & Engineering from the University of Massachusetts (Amherst) in 1982. From 1982 until 1986 he was a senior member of the research staff at the Xerox Research Centre of Canada where he worked on marking materials. Ober joined Cornell University in the Department of Materials Science and Engineering in 1986. He recently served as Interim Dean of the College of Engineering. He is presently Director of the Cornell Nanoscale Facility. 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.

A look back while moving forward: – CNF – Forty Years and Counting

Bob Buhrman

John Edson Sweet Professor of Engineering, Applied and Engineering Physics, Cornell University

222 Day Hall, Cornell University, Ithaca NY 14853
607 255-3732
Email: RAB8@cornell.edu

Abstract:

For the past forty years what is now known as the Cornell NanoScale Science and Technology Facility (CNF) has been providing cutting edge nanotechnology research capabilities to academic, industry and governmental researchers from across the country and around the world, with continuing financial support from the National Science Foundation, New York State, Cornell University, industry contributions and user fees. During these four decades CNF has consistently enabled research that has notably advanced nanoscale science and engineering while extending nanotechnology into new disciplines, facilitating many scientific and technological breakthroughs. It has provided hands-on training to a large number of today's academic and industry leaders in nanotechnology, has led the premier nanotechnology education outreach program in the nation, and has been the exemplar of a successful national user facility; cost-efficient and highly effective in consistently meeting the needs of a user base that is constantly evolving. CNF's success and national impact has continued despite, flat to declining federal funding, the burgeoning number of new nanotechnology research facilities in academia and the development of the DOE Nanocenters. In this brief retrospective I will discuss the key decisions and leadership actions that were critical first to Cornell establishing CNF, and then to ensuring its continuing federal support and its concomitant continuing success as the premier national nanotechnology user facility. I will conclude with some brief comments on the challenges facing CNF today, and the clear opportunities for a highly successful and impactful future for CNF for many years to come despite those challenges.

Biographical Sketch:

Robert Buhrman joined the Cornell Faculty in 1973 and is currently the John Edson Sweet Professor in the School of Applied and Engineering Physics, which he served as Director of Applied and Engineering Physics from 1988 to 1998. Buhrman also served as Cornell's Senior Vice Provost for Research from 2007 to 2017. Buhrman was part of the Cornell faculty team that won the national competition for the original NSF funding for what is now the Cornell Nanoscale Facility (CNF). He served as Associate Director of CNF (NRFSS) from 1980-1983 and as Chair of the CNF Executive Committee from 1985 to 2002. Buhrman was also the founding (2001-2007) Director of the NSF-funded Center for Nanoscale Systems in Information Technologies, which supported multidisciplinary nanoscience research at Cornell from 2001-2012. Buhrman is an Elected Fellow of the American Academy of Arts and Sciences and a Fellow of the American Physical Society. Throughout his career Buhrman's research focus has been in the area now known as nanoscale science and engineering. His current focus is on spintronics and nanoscale magnetism, particularly on the development of spin torque phenomena for electronic applications.

Interfacing with the Brain Using Organic Electronics

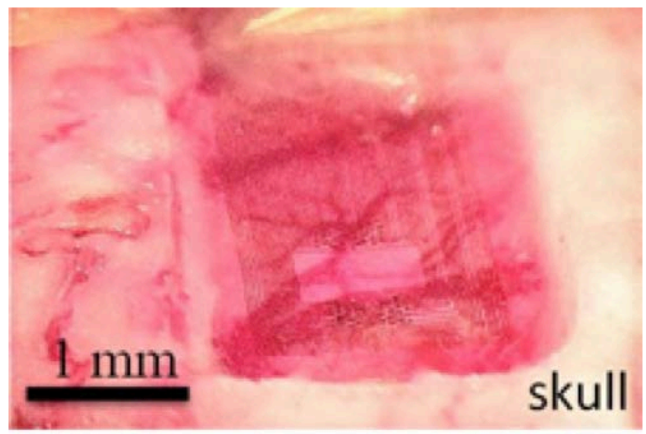
George Malliaras

Department of Engineering, University of Cambridge, UK

gm603@cam.ac.uk
http://www.eng.cam.ac.uk/profiles/gm603

Abstract:

One of the most important scientific and technological frontiers of our time lies in the interface between electronics and the human brain. Interfacing the most advanced human engineering endeavor with nature's most refined creation promises to help elucidate aspects of the brain's working mechanism and deliver new tools for diagnosis and treatment of a host of pathologies including epilepsy and Parkinson's disease. Current solutions, however, are limited by the materials that are brought in contact with the tissue and transduce signals across the biotic/abiotic interface. Recent advances in organic electronics have made available materials with a unique combination of attractive properties, including mechanical flexibility, mixed ionic/electronic conduction, enhanced biocompatibility, and capability for drug delivery. I will present examples of novel devices for recording and stimulation of brain activity that go beyond the current state-of-the-art in terms of performance, compatibility with the brain, and form factor. I will show that organic electronic materials offer tremendous opportunities to design devices that improve our understanding of brain physiology and pathology, and can be used to deliver new therapies.



Organic transistor array placed on the cortex of a rat

Biographical Sketch:

George Malliaras is the Prince Philip Professor of Technology at the University of Cambridge (UK). He received a BS in Physics from the Aristotle University (Greece) in 1991, and a PhD in Mathematics and Physical Sciences, cum laude, from the University of Groningen (the Netherlands) in 1995. After postdocs at the University of Groningen and at the IBM Almaden Research Center (California), he joined the faculty in the Department of Materials Science and Engineering at Cornell University (New York) in 1999. From 2006 to 2009 he served as the Lester B. Knight Director of the Cornell NanoScale Science & Technology Facility. He moved to the Ecole des Mines de St. Etienne (France) in 2009 where he started the Department of Bioelectronics and served as Department Head. He joined the University of Cambridge in 2017. His research on organic electronics and bioelectronics has been recognized with awards from the New York Academy of Sciences, the US National Science Foundation, and DuPont. He is a member of the Hellenic National Council for Research and Technology, a Fellow of the Materials Research Society and of the Royal Society of Chemistry, and serves as an Associate Editor of Science Advances.

Technology Development for the AI Era: Opportunities for Nanotechnology

Dr. Michael A. Guillorn

IBM Research

Email: maguillorn@us.ibm.com

Abstract:

To date, it is fair to question whether or not systems or machines with true artificial intelligence (AI) have been achieved. However, the impact of machine intelligence on daily life is hard to ignore. Algorithms that employ models based on convolutional neural networks (CNNs) for image and speech recognition are widely deployed across the internet in search and social media applications. More complex CNNs with multiple 'hidden' layers, referred to as deep neural networks or DNNs, are being demonstrated on self-navigating vehicles including passenger cars, delivery trucks, and autonomous flying drones. As a further example, DNN-based models are being used to facilitate drug discovery and have produced viable treatments for some forms of cancer, multiple sclerosis, and the Ebola virus. With these facts in mind, it is appropriate to say the AI era has begun.

The growing ubiquity of AI-related technology stems, in part, from the ability to perform the computations required to train and apply DNN-based models in an efficient manner. While there have been vast improvements in the theory and mathematics that underlie the construction and training of DNNs, the impact of advances in computing hardware cannot be overstated. In particular, the availability of processing units tailored to massively parallel computations on large chunks of image data (i.e the graphics processing unit or GPU) was arguably the catalyst for the recent AI revolution. Combined with progress in deep learning algorithms, DNN models that took over a week to train 2 years ago can now be trained in under an hour on massively parallel state-of-the-art GPU computing clusters [1].

The success of the GPU as a computation engine for AI is built upon the achievements of CMOS technology scaling. With dimensional scaling nearing its eventual end, it is reasonable to consider whether or not further gains in computational performance for AI are possible and, if so, how will we achieve these gains. In this talk, I will first review the device and circuit innovations that have been introduced in recent CMOS technology nodes to attain the current computational performance for AI applications. I will then discuss the opportunities for further performance enhancement through the application of emerging nanoscale logic and memory devices.

[1] M. Cho, et al, "PowerAI DDL", arXiv:1708.02188 (2017)

Biographical Sketch:

Dr. Michael A. Guillorn received a PhD in Materials Science and Engineering from the University of Tennessee, Knoxville in 2003. Following the completion of his PhD, Michael worked as a Research Associate at the Cornell Nanofabrication Facility. In 2006, Dr. Guillorn joined the IBM TJ Watson Research Center as a research staff member to undertake research on high density CMOS scaling. Dr. Guillorn led the team that pioneered lateral gate-all-around (GAA) CMOS devices from 2010 to 2016 and also served as the manager of the computational lithography research team from 2015 to 2016. During this time, Dr. Guillorn was deeply involved with design technology co-optimization (DTCO) of CMOS circuits beyond the 10 nm node. Dr. Guillorn's current research focus is on technology and micro-architecture optimization for workload accelerators. Dr. Guillorn has authored over 85 publications in peer-reviewed journals and holds more than 120 US patents.

Molecular Self-Assembly in Topological Defects of Liquid Crystals

Nicholas L. Abbott

Department of Chemical and Biological Engineering, University of Wisconsin-Madison

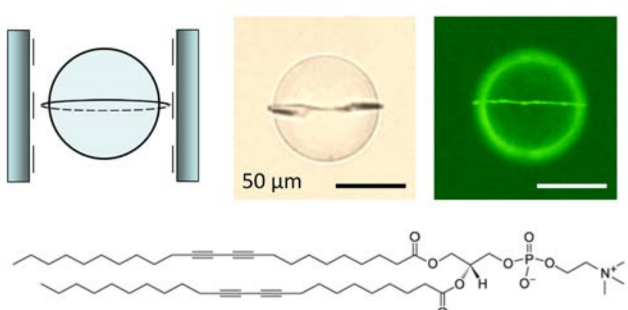
Email: nlabbott@wisc.edu

Abstract:

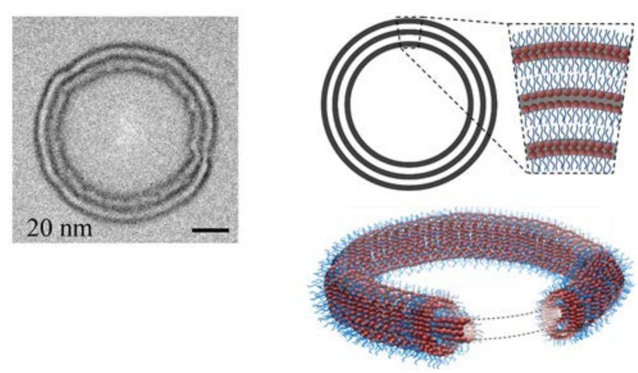
Topological defects are found in the equilibrium states of many confined liquid crystalline phases. However, little is understood about molecular-level organization within topological defects of liquid crystals (LCs). We have recently discovered that the nanoscopic environments defined by LC topological defects can selectively trigger processes of molecular self-assembly. By using fluorescence microscopy, cryogenic transmission electron microscopy and super-resolution optical microscopy, we have observed signatures of molecular self-assembly of amphiphilic molecules in LC topological defects, including cooperativity, reversibility and controlled growth. We have used the molecular self-assembly process to provide new insights into the nanoscopic structure of LC topological defects. We have found, for example, that "point defects" are, in fact, nanoscale disclination loops. Analogies to other classes of macromolecular assemblies, such as polymer-surfactant complexes, have also been established. Overall, topological defects in LCs are a versatile class of three-dimensional, dynamic and reconfigurable templates for molecular self-assembly. They offer substantial technological promise.

Biographical Sketch:

Nicholas Abbott is the Sobota Professor and Hilldale Professor of Chemical and Biological Engineering at University of Wisconsin-Madison, and the Director of the Wisconsin Materials Research Science and Engineering Center. He received a Bachelor of Engineering (Chemical Engineering) from University of Adelaide, Australia in 1985, and a PhD in Chemical Engineering from Massachusetts Institute of Technology in 1991. He was a postdoctoral fellow in the Chemistry Department of Harvard University from 1991-1993. His research interests revolve around soft materials, interfacial phenomena and colloid science. His contributions have been acknowledged by the 2016 American Chemical Society Award in Colloid and Surface Chemistry, and the 2012 Alpha Chi Sigma Award of AIChE for Chemical Engineering Research. He is an APS fellow and member of the US National Academy of Engineering. He currently serves as Editor-in-Chief of Current Opinion in Colloid and Interface Science.



Caption 1: (left). Schematic illustration of a disclination loop ("Saturn ring") formed around a solid microsphere dispersed in a nematic liquid crystal. (center) Topological defects in liquid crystals scatter light and can be readily observed by optical microscopy. (right) Molecular self-assembly of phospholipids within the nanoscopic cores of disclinations of liquid crystals can be reported by fluorescence emission (BODIPY-labeled phospholipids). (bottom). Assemblies formed by phospholipids within defects can be preserved by UV-triggered cross-linking of diacetylenic lipids.



Caption: Electron micrograph (left) and schematic illustration (right) of a nanoscopic toroid formed by self-assembly of amphiphiles within the core of a "point defect" (strength +1) of a nematic liquid crystal. The scale bar is 20 nm.

From Silicon to Plastic: A Path to Robust Stretchable Devices

Guoyan Zhang, Michael McBride, Elsa Reichmanis

School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, Atlanta, GA 30332

Email: ereichmanis@chbe.gatech.edu
http://reichmanis.chbe.gatech.edu/

Abstract:

Printed, flexible and even stretchable electronics have potential as low cost alternatives for devices in industries ranging from energy to health care to security. The successful introduction of these devices however, relies on the design and development of sustainable, robust and reliable materials and processes. Studies have shown that not only does device performance depend critically on semiconductor alignment at many length scales, but importantly, materials' nano- through meso-structure can be manipulated in solution prior to device fabrication. Recently, it has been demonstrated that even with no perturbations, polymer semiconductors self-assemble in solution over time. Observations surrounding the behavior of these materials suggest that requisite macroscopic long-range order required for high performance devices may be achieved through process optimization which utilizes knowledge associated with materials structure-process-property relationships. Note for instance, the orientation of fibrils presented in Figure 1. These insights have been successfully applied to the design of semiconducting films comprising interpenetrating polymer networks that afford films with significantly improved mechanical elasticity and optical transparency, without affecting electronic conductivity even under 100% strain. The approach facilitates fabrication of large area stretchable devices through straightforward solution processing techniques (Figure 2). Robust transistor arrays fabricated from commercially available materials exhibited charge carrier mobilities above 1.0 $cm^2/V\cdot s$ with excellent durability, even under 100% strain. Manufacturable, stretchable devices present promising directions for devices in a range of industries including health care, security, and energy.

Biographical Sketch:

Elsa Reichmanis is Professor and Pete Silas Chair in Chemical Engineering, and Brook Byers Professor of Sustainability in the School of Chemical and Biomolecular Engineering of the Georgia Institute of Technology. Prior to joining Georgia Tech, she was Bell Labs Fellow and Director of the Materials Research Department, Bell Labs, Murray Hill, NJ. She received her Ph.D. and BS degrees in chemistry from Syracuse University. She is a member of the National Academy of Engineering and has received several awards for her work. She has also been active in professional societies, having served as 2003 President of the ACS. She has participated in many National Research Council activities and is an Executive Editor for the ACS journal, Chemistry of Materials. Her research, at the interface of chemical engineering, chemistry, materials science, optics, and electronics, spans from fundamental concept to technology development and implementation. Her interests include the chemistry, properties and application of materials technologies for photonic and electronic applications, with particular focus on polymeric and nanostructured materials for advanced technologies. Currently, efforts aim to identify fundamental parameters that will enable sub-nanometer scale dimensional control of organic, polymer and/or hybrid semiconductor materials.

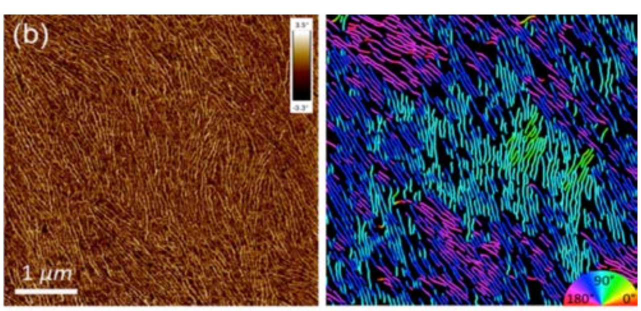


Figure 1. AFM phase image of thin film from microfluidic-cooling-UV processed solution. Fibers were extracted and their orientations labeled using GTFiber [gtfiber.github.io]

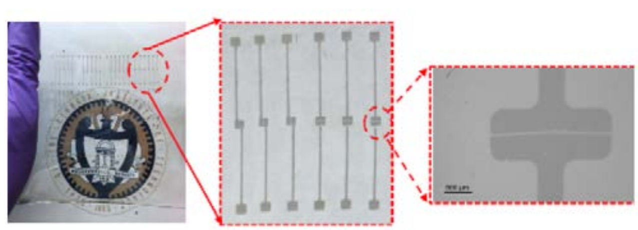


Figure 2. Optical images of integrated, transparent, stretchable transistor arrays.

Lance R. Collins

Mechanical and Aerospace Engineering, Cornell University

Joseph Silbert Dean of Engineering, Professor

Address: 242 Carpenter Hall
Phone: 607 255-9679
Email: LC246@cornell.edu

Biographical Sketch:

Professor Lance R. Collins is the Joseph Silbert Dean of Engineering at Cornell University. Prior to that he served as the S. C. Thomas Sze Director of the Sibley School of Mechanical & Aerospace Engineering from 2005-2010, and he was Director of Graduate Studies for Aerospace Engineering 2003-2005. Collins joined Cornell in 2002, following 11 years as Assistant Professor, Associate Professor and Professor of Chemical Engineering at Pennsylvania State University. From 1999 until his departure, he also held a joint appointment in the Mechanical & Nuclear Engineering Department at Penn State, and in 1998 he was a visiting scientist at the Laboratoire de Combustion et Systémes Réactifs (a National Center for Scientific Research laboratory in Orleans, France) and at Los Alamos National Laboratory. In 2011, Dean Collins was part of the Cornell leadership team that successfully bid to partner with New York City to build a new campus on Roosevelt Island focused on innovation and commercialization in the tech sector.

Research Interests:

Professor Collins' research interests are on the application of direct numerical simulation to a broad range of turbulent processes. Areas of current interest include: (i) turbulent coagulation of aerosol particles; (ii) experimental and numerical evaluation of Lagrangian statistics in turbulent flows; (iii) mixing and chemical reaction in turbulent flames; (iv) turbulent breakup of microstructures (e.g., drops, polymers and red blood cells); (v) drag reduction due to polymer additives. A unifying theme is the importance of fine---scale (micro---turbulence) transport to these phenomena. A second focus is on developing a new class of turbulence models that are capable of describing micro---turbulence processes. Recent contributions have been made toward extending fundamental spectral theories of turbulence to applications (i) and (ii). Current emphasis is on validating the models and incorporating them into computational fluid dynamics codes.

Origami with 2D Materials

Paul L. McEuen

John A. Newman Professor of Physical Science, Cornell University

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Abstract:

For centuries, practitioners of the paper arts of origami ("ori"=fold) and kirigami ("kiri"=cut) have created beautiful and complex structures from a sheet of paper. Here we show that 2D materials are a perfect starting material for microscale paper arts. We first demonstrate that we can, with the right tools, pick up a single sheet of graphene and manipulate it like a sheet of paper. We then apply ideas from kirigami to pattern the graphene into a variety of shapes and explore their properties. These include stretchable electrodes, springs, and robust hinges. Next, we create nanometer-thick bimorphs by pairing a 2D material with another thin film. These bimorphs are the basis of active hinges that actuate in response to external chemical, electrical, or optical signals. We argue that these materials, when coupled with other electronic and optical devices, can be the basis of a new generation of micron-scale smart machines.

Biographical Sketch:

Paul McEuen is the John A. Newman Professor of Physical Science at Cornell University and Director of the Kavli institute at Cornell for Nanoscale Science. His research explores the electronic, optical, and mechanical properties of nanoscale materials; he is currently excited about using these materials to construct functional micron-scale machines. He is also a novelist, and his scientific thriller SPIRAL won the debut novel of the year from the International Thriller Writers Association. He is a fellow of the American Physical Society, the National Academy of Sciences, and the American Academy of Arts and Sciences.

The Importance of a Nano-Fabrication Facility in Materials Innovation for Advanced Electronics

Robert D. Allen, Ph.D.

Senior Manager,
Materials Innovation Department
Distinguished Research Staff Member

Almaden Science & Technology

IBM Almaden Research Center

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Abstract:

Materials innovation enables future technology. One critical component of a research facility dedication to device fabrication is the opportunity to explore new materials. In my talk, I will describe examples of materials exploration and innovation in our nano-fab research lab, the Almaden Nanofabrication Facility.

Biographical Sketch:

Robert D. Allen is a Distinguished Research Staff Member and Senior Manager of the Materials Discovery and Innovation Department at the IBM Almaden Research Center in San Jose, California. He leads chemical/materials research for IBM.

Dr. Allen grew up in Sharon, Pennsylvania and attended Gannon College in Erie, PA where he received his B.S. in Chemistry. Dr. Allen studied polymer chemistry at Virginia Tech under the direction of Prof. James E. McGrath where he received his Ph.D. for his work on living anionic polymerization in 1985. He joined the IBM Almaden Research Center in 1985, where he was introduced to the world of photoresists under the direction of Dr. C. Grant Willson. Dr. Allen was awarded the title of SPIE Fellow for his pioneering work in the development of 193nm photoresists. He is a member in the National Academy of Engineering and won the 2014 ACS Award in Industrial Polymer Chemistry and in 2015 was named a Fellow of the Polymer Division of the ACS. Dr. Allen was recently elected to the Virginia Tech College of Science's Hall of Distinction and also received the Virginia Tech alumni achievement award.

Flex-Hybrid Electronics: Revolutions from Health Monitoring to Aerospace

Richard A Vaia
Technical Director

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Materials and Manufacturing Directorate,
Air Force Research Laboratory,
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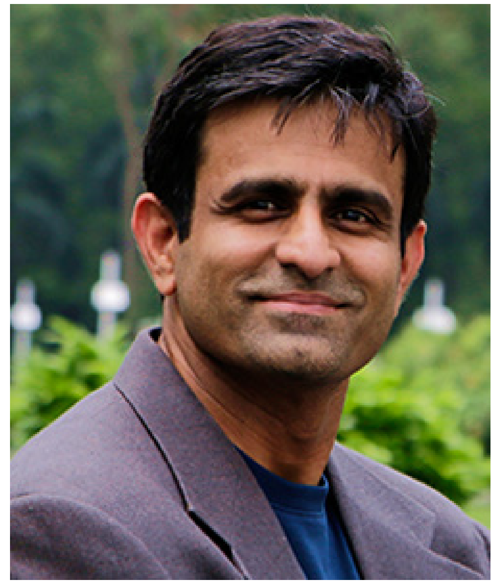
Abstract:

IoT concepts, hardware and systems-of-systems will revolutionize the Aerospace Enterprise, whether it is more effective logistics and life-cycle management or new capabilities, such as human-machine teaming. The heart of these opportunities arise from the convergence of ultrathin devices from the fab with recent advances in functional print and additive. These innovations are expanding the trade space by seamlessly integrating components for sensing, processing, communication and energy into a monolithic, stretchable, compliant package – flexible hybrid electronics (FHE). After a brief discussion of opportunities, this talk will consider some materials and processing requirements that are challenging the FHE community, including integration of nanoscale subtractive with additive technologies; gradation of properties across length scales; strain-insensitive interconnects; massively parallel nano-registration; metrology and inspection; and multi-physics optimization design tools.

Biographical Sketch:

Richard A. Vaia is the Technical Director of the Functional Materials Division at the U.S. Air Force Research Laboratory (AFRL). The 200+ scientists and engineers he leads delivers materials and processing solutions to revolutionize AF capabilities in Survivability, Directed Energy, Reconnaissance and Human Performance. Additionally, Rich has published more than 200 articles (26000 citations, H-index 72) on nanomaterials, with honors including the AF McLucas Award for Basic Research, ACS Doolittle Award, Air Force Outstanding Scientist, Air Force Office of Scientific Research Star Teams, and Fellow of the Materials Research Society, American Physical Society, American Chemical Society, and the Air Force Research Laboratory.

IoT - For Sports, Entertainment and Social Impact



Narayan Sundararajan

Principal Engineer and Director, New Technology Group, Intel

narayan.sundararajan@intel.com

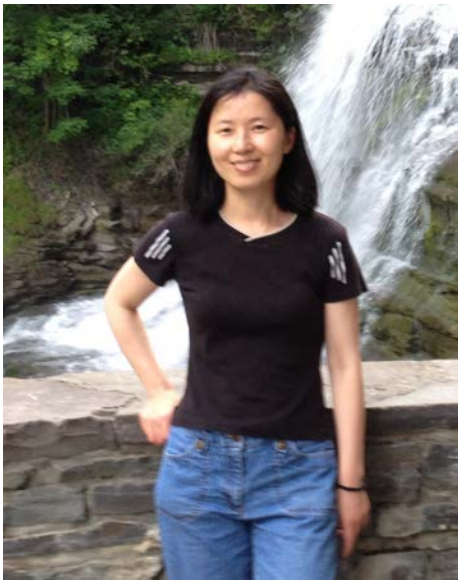
Abstract:

Can we measure the g-force when the snowboarder lands after a jump? How fast is a cricket batsmen swinging the bat and how well are they timing the ball? Can we generate music using gestures seamlessly integrated into the performance? How can some of these same technologies be redirected to address large scale global issues in developing countries to have major social impact?

The talk will take the audience through use cases across the broad spectrum of sports to entertainment to social impact and provide examples of concepts, prototypes and products of IoT and wearable devices.

Biographical Sketch:

Narayan Sundararajan is a Principal Engineer and Director in the New Technology Group at Intel focused on wearables and Internet of Things for Sports, Arts and Entertainment. He also serves as the Chief Technology Officer (CTO) of Grameen Intel Social Business overseeing development of technology solutions for solving large scale global social problems in healthcare and agriculture. Prior to this, Narayan has traversed various technical, business and management roles at Intel working in New Business Initiatives (NBI), Digital Health Group (DHeG) and Corporate Technology Group (CTG). Narayan holds 37+ patents issued with 45+ pending. He also has published 35+ peer-reviewed papers and co-authored a book titled "Micro fabrication for Micro fluidics" published by Artech Publishers with another book, "The Rule of One: Grameen Intel and the Power of Social Entrepreneurship." in the press. Educated at the Indian Institute of Technology (B.Tech) and Cornell (M.S, Ph.D.), Narayan is also a freelance actor, documentary and film-maker.



Photonics and optoelectronics of 2D semiconductors

Jie Shan

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The Pennsylvania State University

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Abstract:

Recent advances in the development of atomically thin layers of van der Waals bonded solids have opened up new possibilities for the exploration of 2D physics as well as for materials for applications. Among them, semiconductor transition metal dichalcogenides, MX2 (M = Mo, W; X = S, Se), have bandgaps in the near-infrared to the visible region, in contrast to the zero bandgap of graphene. In the monolayer limit, these materials have been shown to possess direct bandgaps, a property well suited for photonics and optoelectronics applications. In this talk, I will discuss the electronic and optical properties and the recent progress in applications of 2D semiconductors with emphasis on the strong light-matter interaction and properties associated with the electron's spin and valley degree of freedom.

Biographical Sketch:

Jie Shan received her diploma in Mathematics and Physics from Moscow State University, Russia in 1996 and Ph.D. in Physics from Columbia University in 2001. She joined the physics faculty at Case Western Reserve University in 2002 and moved to Penn State University in 2014, where she is currently a professor of physics. Research in her group is focused on experimental studies of the electronic and optical properties of condensed matter systems. Current activities have involved the investigation of novel 2D atomic crystals such as graphene and transition metal dichalcogenides.

IOT Everywhere–Sounds Great, but What Are the Hidden Challenges?

Richard E. Howard

Winlab, Rutgers University

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Abstract:

A google search for “IOT” shows up about 31M hits, vs only 1.5M for “autonomous vehicles”—a clear indication of which technology people think will be transformational. Any technology with that potential level of impact is a good candidate for a closer look at the underlying science on which the engineering (and market claims) are based.

One of the use cases for IOT is to put vast numbers of inexpensive nodes in locations where people would like to gather information and, perhaps, act on that information. In many places (e.g. cars, homes, etc.) this problem is greatly simplified by the access to energy and communications that is inherent in such complex systems. On the other hand, many of the places generating useful information are interesting precisely because there are neither people nor expensive systems in that environment (e.g. inside an automobile tire, under a kitchen sink, or in the hem of a jacket). In this case, any IOT node will have to manage limited resources--sensing, computation, security, energy, and communication--if it is to collect and return useful knowledge about these locations.

There are some interesting fundamental physical limitation in each of these areas and, in many cases, possible alternative approaches that could benefit from the technology base in the CNF. I will give some pointers to representative problems in the area of energy management, wireless communication, and security/authentication that need to be addressed before IOT reaches the level of ubiquity (and actual usefulness) that would match its current promise.

Biographical Sketch:

Richard E. Howard retired as the Vice President, Wireless Research, Bell Labs, Lucent Technologies in 2001 and is currently, a research professor at the Rutgers University Wireless Information Laboratory (Winlab), and the CTO of Inpoint Systems, Inc. He has a PhD in Applied Physics from Stanford University and a BSc in Physics, from California Institute of Technology.

In addition to his work on wireless technology, during his 22 year career at Bell Labs he was also Vice President, Silicon Integrated Circuit Research and, before that, he managed and conducted research in areas that included machine learning, nanophysics and nanofabrication, quantum effects in nanostructures, superconducting and semiconducting materials and devices, VLSI technology, and photonics. Currently, he is exploring new approaches to ultra-low energy ubiquitous sensor networks through a partnership between Winlab and Inpoint Systems.

He is a Fellow of both the American Physical Society and the American Associated for the Advancement of Science, as well as a Senior Member of Institute of Electrical and Electronics Engineers. In 1985 he shared the Paul Rappaport Award from the IEEE.

Other activities include: Chair, Design and Test Technology Working Group of the SIA National Technology Roadmap for Semiconductors Project 1989-1999; Organizing Committee for Machines that Learn Workshop 1986-1996, Organizing Committee for the Workshop on Frontiers in Distributed Information Systems 1995-2008; member of the Digital Connections Council of the Committee for Economic Development 2000-2007, and member of Committee on Using Information Technology to Enhance Disaster Management--National Research Council of the National Academies of Science and Engineering 2005-2007.

CENTER POSTER 1

Poster Title: Nano-CT at the BRC-Imaging Core

Author(s): Teresa Porri, Rebecca Williams
Principal Investigator(s): Rebecca Williams
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CENTER POSTER 2

Poster Title: CNF has assumed several tool sets from the former Nanobiotechnology Center (NBTC)

Author(s): Beth Rhoades
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CENTER POSTER 3

Poster Title: Biotechnology Resource Center

Author(s): James VanEe, Jarek Pillardy, Peter Schweitzer, Rebecca Williams, Sheng Zhang
Affiliation(s): All affiliations are Cornell University Institute of Biotechnology
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1

Poster Title: Collimating Channel Arrays Development at CHESS for High Resolution Confocal X-ray Fluorescence Microscopy.

CNF Project #: 217212
Author(s): David Agyeman-Budu, Sanjukta Choudhury, Ian Coulthard, Robert Gordon, Arthur Woll
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2

Poster Title: Micro-patterning of Nonplanar Surfaces: a Route from Microfabrication on 2D Si Wafers to 3D Medical Devices

Author(s): Seyedhamidreza Alaie1,2, Sanlin S. Robinson3, Amir Ali Amiri Moghadam1,2, Jordyn Auge1,2, Amit Datye1,2,4, Hannah Sidoti1,2, Tejas Doshi1,2, Saleh HassanzadehGharaie1,2, James K. Min1,2, Bobak Mosadegh1,2, and Simon Dunham1,2
Principal Investigators: James K. Min, Simon Dunham, and Bobak Mosadegh
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3

Poster Title: Influence of hierarchical structures on lipase stability in extreme environments

Author(s): Stephanie M. Andler, Li-Sheng Wang, Vincent M. Rotello, Julie M. Goddard
Principal Investigator(s): Julie M. Goddard
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4

Poster Title: Wide-bandgap Gallium Nitride p-channel MISFETs

CNF Project: 243516
Author(s): Kazuki Nomoto, Samuel James Bader [presenting], Kevin Lee, Shyam Bharadwaj, Zongyang Hu, Huili Grace Xing, Debdeep Jena
Principal Investigator(s): Debdeep Jena
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5

Poster Title: Quantum Well Heterostructure FETs on Aluminum Nitride Platform

CNF Project Number: 2470-16
Author(s): Austin Hickman (presenter), Reet Chauduri, Samuel Bader, Kazuki Nomoto, SM Islam, Huili Xing, Debdeep Jena
Principal Investigator(s): Debdeep Jena
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6

Poster Title: A Biocompatible and High Stiffness Nanophotonic Trap Array for Precise and Versatile On-chip Manipulation

CNF Project #: 173808
Author(s): Ryan Badman1, Fan Ye1,2, James Inman1,2, Mohammad Soltani1,2,3, Jessica Killian1, and Michelle D. Wang1,2
Principal Investigator(s): Michelle D. Wang
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7

Poster Title: Out-of-Plane MEMS for near-field radiative heat transfer

CNF Project: 236415
Author(s): Gaurang R. Bhatt, Samantha Roberts, Raphael St-Gelais, Tong Lin, Bo Zhao, Jean-Michel Hartmann, Shanui Fan and Michal Lipson
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Poster Title: Nanoscale Sheets for Rapid Bidirectional Folding

CNF Project #: 241616
Author(s): Baris Bircan, Marc Z. Miskin, Kyle J. Dorsey, Paul L. McEuen, Itai Cohen
Principal Investigator(s): Itai Cohen
Affiliation(s): School of Applied and Engineering Physics, Cornell University; Laboratory of Atomic and Solid State Physics, Kavli Institute at Cornell for Nanoscale Science
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9

Poster Title: Nano-scale Magnetic Resonance Imaging: Spin-noise or Dynamic Nuclear Polarization?

CNF Project number: 86300
Author(s): Michael Boucher, Hoang Nguyen, Corinne Isaac, John Marohn
Principal Investigator(s): John Marohn
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Poster Title: Synthesis and solution-phase characterization of sulfonated oligothioetheramides

Author(s): Joseph S Brown, Yaset M Acevedo, Grace D He, Paulette Clancy, and Christopher A. Alabi
Principal Investigator(s): Christopher A. Alabi
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Poster Title: Large Scale Growth of Hexagonal Boron Nitride on Metallic and Non-Metallic Substrates.

CNF Project #: 243516
Author(s): Ryan Page, Brian Calderon^, Yongjin Cho^, Huili Xing*^, Debdeep Jena*^.*
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Poster Title: FeverPhone: Point of Care Diagnosis of Acute Febrile Illness using a Mobile Device

CNF Project #: 2317-14
Author(s): Xiangkun (Elvis) Cao, Yvon Serge Ongagna Yhombi, and David Erickson
Principal Investigator(s): David Erickson
Affiliation(s): Sibley School of Mechanical and Aerospace Engineering, Cornell University
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Poster Title: GaN Fin-TFETS

CNF Project #: 237715
Author(s): Alexander Chaney, Henryk Turski, Kazuki Nomoto, Zongyang Hu, Huili Grace Xing, Debdeep Jena
Principal Investigator(s): Prof. Debdeep Jena
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Poster Title: Reduced lateral confinement and its effect on stability in patterned polyelectrolyte brushes

CNF Project #1757-09
Author(s): Wei-Liang Chen, Matthias Menzel, Oswald Prucker, Tsukasa Watanabe, Jürgen Rühe
Principal Investigator(s): Christopher Kemper Ober
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Poster Title: Microtechnical processing of liquid crystal elastomers

CNF Project #6635
Author(s): Wei-Liang Chen, David Ditter, Hans Zappe, Christopher K. Ober
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Poster Title: Laser Annealing of Wide Bandgap III-V Materials

CNF Project #150-82
Author(s): Emily R. Cheng (1) , Victoria C. Sorg (1), Hsien-Lien Huang (1), Huili Xing (3) , Paulette Clancy (1), Michael O. Thompson (2)
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Poster Title: Dopant Activation in III-V materials following Laser Spike Annealing

CNF Project #: 150-82
Author(s): Hsien-Lien (Steve) Huang
Principal Investigator(s): Dr. Michael O. Thompson
Affiliation(s): Chemical and Biomolecular Engineering, Cornell University
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Poster Title: A Biosensor Platform for Lyme Disease Detection using the Antibody Water Oxidation Pathway.

CNF Project #: 175709
Author(s): Roselynn Cordero, Wei-Liang Chen, Pranav Sundaram, Andrew Sanchez, Brian Kirby, and Christopher Ober.
Principal Investigator(s): Christopher Ober
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Poster Title: Development of Single and Double Layer Anti-Reflective Coatings for Astronomical Instruments

CNF Project #: 245816
Author(s): Nicholas F Cothard, Kenny Vetter, Gordon Stacey, Michael Niemack, Patricio Gallardo
Principal Investigator(s): Gordon Stacey
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Poster Title: Artificial Muscle Stem Cell-Niche Fabrication Using Microfluidically Generated Hydrogel Beads

CNF Project #: 246116
Author(s): Andrea J. De Micheli, M.S. Ashritha Bheemidi Benjamin D. Cosgrove Ph.D.
Principal Investigator(s): Benjamin D. Cosgrove
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Poster Title: CCMR - 2D Atomic Membranes

Principal Investigator(s): Robert A. DiStasio Jr.
Affiliation(s): Cornell University, Department of Chemistry and Chemical Biology
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Poster Title: Hyperspectral Interference Microscopy of Crumpled Graphene

CNF Project: 900-00
Author(s): Kyle Dorsey, Marc Miskin, Itai Cohen, Paul McEuen
Principal Investigator(s): Paul McEuen
Affiliations: KD: School of Applied and Engineering Physics, Cornell University; MM, IC, PM: Kavli Institute at Cornell for Nanoscale Science, Laboratory for Atomic and Solid State Physics, Cornell University

23

Poster Title: New Tunneling Features in Polar III-Nitride Resonant Tunneling Diodes

CNF Project #: 2443-16
Author(s): Jimy Encomendero, Faiza Afroz Faria, S. M. Islam, Vladimir Protasenko, Sergei Rouvimov, Berardi Sensale-Rodriguez, Patrick Fay, Debdeep Jena, and Huili Grace Xing.
Principal Investigator(s): Grace Xing
Affiliation(s): School of Electrical and Computer Engineering, Cornell University
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Poster Title: Deep-Tissue Photonic Needles

CNF Project #: 236415
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Principal Investigator(s): Michal Lipson
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Poster Title: Effectively infinite optical path-length in a 3D photonic crystal for extreme light-trapping

CNF project #: 217312
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Principal Investigator(s): Shawn-Yu Lin
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Poster Title: Anomalous Hall Generation of Spin Currents with Controllable Spin Polarization

CNF Project Number: 598-96
Author(s): Jonathan D. Gibbons, David MacNeill, Robert A. Buhrman, and Daniel C. Ralph
Principal Investigators: Daniel C. Ralph, Robert A. Buhrman
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Poster Title: Spin Transfer Torques in Soft Co/Pt Bilayers

CNF Project #: 598-96
Author(s): Jennifer Grab, Alison Rugar, Robert Buhrman, Dan Ralph
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Poster Title: Surface Modified CMOS IC Electrochemical Sensor Array Targeting Single Chromaffin Cells for Highly Parallel Amperometry Measurements

CNF Project #: 246016
Author(s): Meng Huang1,2, Joannalyn B. Delacruz1, John C. Ruelas3, Shailendra S. Rathore1, Manfred Lindau1
Principal Investigator(s): Manfred Lindau
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Poster Title: Microfluidics for modeling biological flows in breast tumor cell invasion

CNF Project #: 206811
Author(s): Yu Ling Huang, Yujie Ma, Min Seo Kang, Anqi Zheng, Chih-kuan Tung, and Mingming Wu
Principal Investigator: Dr. Mingming Wu
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Poster Title: Protocols for Imaging Individual Nitroxide Electron Spins with Atomic Precision

CNF Project #: 212512
Author(s): Corinne Isaac, Hoang Long Nguyen, Michael Boucher, and John Marohn
Principal Investigator(s): John Marohn
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Poster Title: High Confinement and Low Loss Si3N4 Waveguides for Miniaturizing Optical Coherence Tomography

CNF Project Number: 236415
Author(s): Xingchen Ji, Xinwen Yao, Mohammad A. Tadayon, Aseema Mohanty, Christine P. Hendon, and Michal Lipson
Principal Investigators: Michal Lipson
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Poster Title: Optical absorption and emission mechanisms of single defects in hexagonal boron nitride

CNF Project #: 212612
Author(s): Nicholas R. Jungwirth and Gregory D. Fuchs
Principal Investigator(s): Gregory D. Fuchs
Affiliation(s): AEP
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Poster Title: Monolithic Electrostatic Quadrupole Array for Multi-beam Particle Accelerator

CNF Project #: 112103
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Poster Title: Multi-functional Platform for the Characterization of Nanostructured Polymer Brushes

CNF Project #: 2017 CNF REU Program
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Poster Title: Graphene Film Crystal Mount for X-Ray protein crystallography experiment

CNF project # 246716
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Poster Title: Harmful Algal Bloom-Microfluidic device for studying algae bloom

CNF Project #: 226213
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Poster Title: Vertical Tunneling Field Effect Transistors (Thin-TFET) Based on Black Phosphorus

CNF Project #: 230614
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Poster Title: Deep UV Photonic Devices using Quantum Dots

CNF Project no. 238715
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Poster Title: Micro-scale Opto-electronically Transduced Electrode Sites (MOTES) for Wireless Recording of Neural Activities

CNF Project #: 257817
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Poster Title: GaN vertical power transistors

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Poster Title: UV-based Nanoimprint Lithography - An Enabling Technology for MEMS and Nanophotonics

CNF Project: CNF Fellow
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Poster Title: Nanophotonics Enables Spectroscopy on TiO_2 Surfaces

CNF Project #: 225513
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Poster Title: A rapid diagnostic testing platform for iron and vitamin A deficiency

CNF Project #: 231714
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Poster Title: Self-referenced temperature sensing with a lithium niobate microdisk resonator

CNF Project # 199711
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Poster Title: Electrostatic Behavior of Rippled Graphene Sheets in Solution

CNF Project #: 900-00
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Poster Title: Design and Demonstration of a Pumpless 14 Compartment Microphysiological System

CNF Project # 731-98
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Poster Title: Graphene-Bimorphs for Micron Scaled Machines

CNF Project # 900-00
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Poster Title: Fabrication of Superconducting Quantum Circuits and Integrated Control Electronics

CNF Project # 131405
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Poster Title: Detecting Cell Action Potentials with Graphene Field-Effect Transistors

CNF Project #: 900-00
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Poster Title: Magnetically Actuating Graphene Origami and Kirigami

CNF Project #: 900-00

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Poster Title: Small Intestine Motility Simulator for Enhanced Studies of Intestinal Activity

CNF Project #: 229814

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Poster Title: Improving Oil Detection and Extraction Efficiency by Using Hairy Nanoparticles

CNF Project #: 238515

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Poster Title: Synthetic Small Intestinal Implants for the Treatment of Short Bowel Syndrome

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Poster Title: Fabrication of a microfluidic chip for point of care cortisol measurement

CNF Project #: 187210

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Poster Title: Optical Electrochemical Sensing with Monolayer MoS_2

CNF Project #: 900-00

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Poster Title: Large Temperature-Dependent Spin Hall Effect in $YbAl_3$

CNF Project #: 598-96

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Poster Title: Microfluidic Platform for Biomechanical Testing of Bacteria

CNF Project #: 197010

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Poster Title: Integrated Graphene Phase Modulator

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Poster Title: PMMA/PS Block Copolymer Lithography for Periodic sub-25nm Features

CNF Project #: CNF Fellows

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Poster Title: Separation of submicron particles in Fabry-Perot acoustofluidic resonators

CNF Project # 234915

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Poster Title; Fast, low-current spin-orbit switching of magnetic tunnel junctions using Hf interface engineering

CNF Project #; 111-80

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Poster Title: Control of Spin-Orbit Torques Through Crystal Symmetry

CNF Project # 598-96

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Poster Title: Roles of Ribose Glycation in 3D Tumor Cell Motility and Collective Dynamics

CNF Project #: 206811

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Poster Title: Reduction of the Spin Hall Efficiency in Oxygen-Doped Beta Tungsten

CNF project number: 111-80

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Poster Title: 5-Organ Microphysiological System for Drug Screening

CNF Project #: 731-98
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Poster Title: Role of van der Waals Interactions in Alleviating Epitaxial Strain in WS_2/WSe_2 Lateral Heterojunctions.

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Poster Title: Spin waves in a chiral magnet FeGe

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Poster Title: Electronic transport of topological one dimensional channels bilayer graphene

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Poster Title: Epitaxial Superconductor/Semiconductor Heterostructures

CNF Project #: 2443-16
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Poster Title: Large-scale CMOS-compatible Processing of MoS_2 MOSFETs

CNF Project: 250915
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Poster Title: EUV Metal Oxide Hybrid Photoresists: Ultra-small Structures for High Resolution Patterning

CNF Project #: 386-90
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Poster Title: Non-Covalent Interactions in Covalent Organic Frameworks

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Poster Title: Tunable nanophotonic array traps with enhanced force and stability

CNF Project #: 173808
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Poster Title: Pathways to mesoporous resin/carbon thin film templates with alternating gyroid morphology

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Poster Title: Thermal conductivity and interfacial thermal conductance of boron nitride encapsulated MoS_2

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Poster Title: Amino acid based PEUUs with patterned surface and its influence on macrophage behavior

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Poster Title: Heusler B2-Co_2MnSi-based Magnetic tunneling junctions on Silicon

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Poster Title: Measurement and Modeling of Water Transport Dynamics with high temporal resolution in Apple Trees

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