

# A Decade of Discovery

10 years of nanoscience at the  
Center for Functional Nanomaterials

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Director

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Assistant Director for  
Strategic Partnerships

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Center for Functional Nanomaterials



Center for Functional  
Nanomaterials



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



Center for Functional  
Nanomaterials

# Advancing nanoscience to impact society

- A national user facility operated for the
  - (One of five DOE Nanoscale Science Research Centers)



U.S. DEPARTMENT OF  
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- Started user operations in 2008
- Brookhaven Lab's nanoscience department
- A resource of world-class tools and nanoscience expertise for the world
- Permanent staff: 40+ (30 scientists)

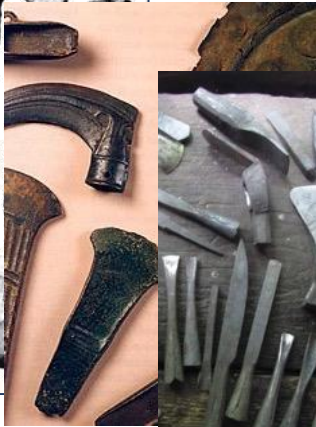


# The CFN impacts society by understanding/improving materials

- We aspire to participate in delivering the nanomaterial discoveries for the 21<sup>st</sup> century



Stone Age



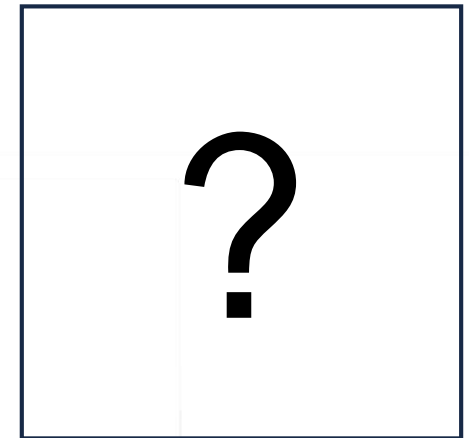
Bronze Age



Iron Age



20<sup>th</sup> Century: e.g., Silicon, Steel, Plastics, ...

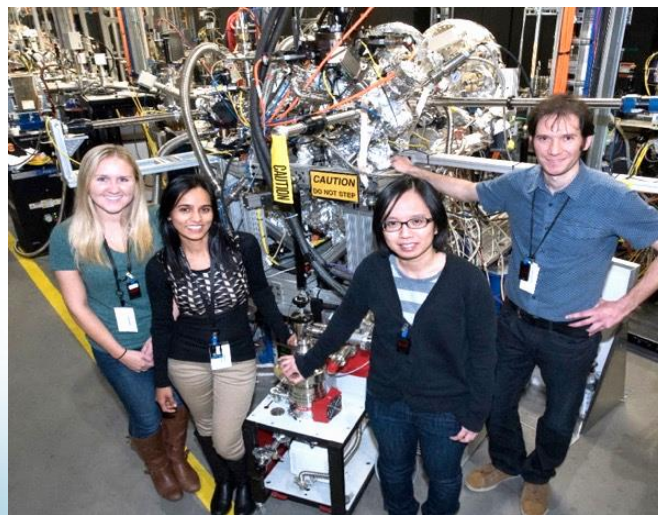
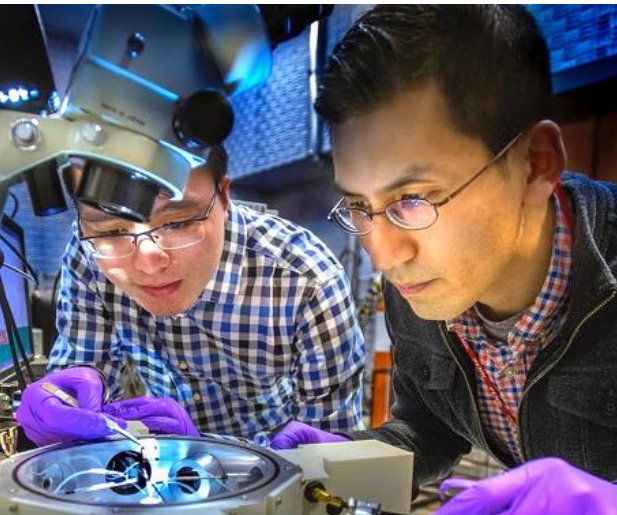


21<sup>st</sup> Century



# 10-year Anniversary Event

- People, working together, are the foundation of the CFN success
- Our event was primarily about recognizing and celebrating that
- A day for staff, former staff, users, and all of BNL
- Recognize everyone who has contributed
- Look ahead to an even brighter future with greater impact





# CFN Assistant Director for Strategic Partnerships

Dr. Priscilla Antunez

- Joined CFN in December 2018

Background and Experience:

- Tech Transfer & Partnerships at Argonne National Laboratory
- Research at IBM Thomas J Watson Research Center
- PhD Chemistry (USC)
- Industrial and Management Systems Engineering (Universidad de Sonora)



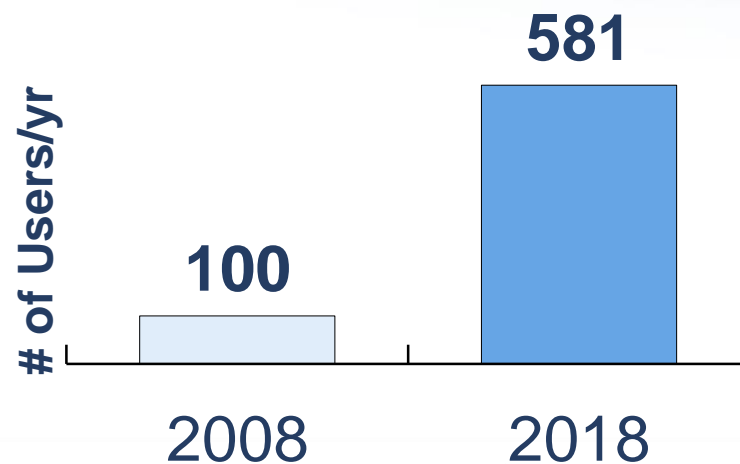
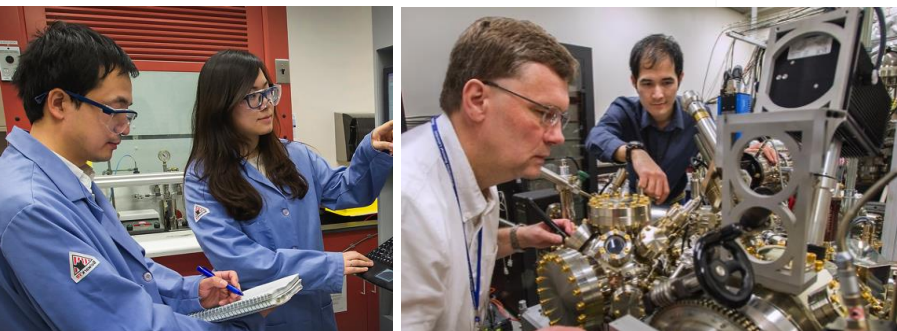
# CFN 10-year anniversary event

- Two-minute video with speaker highlights

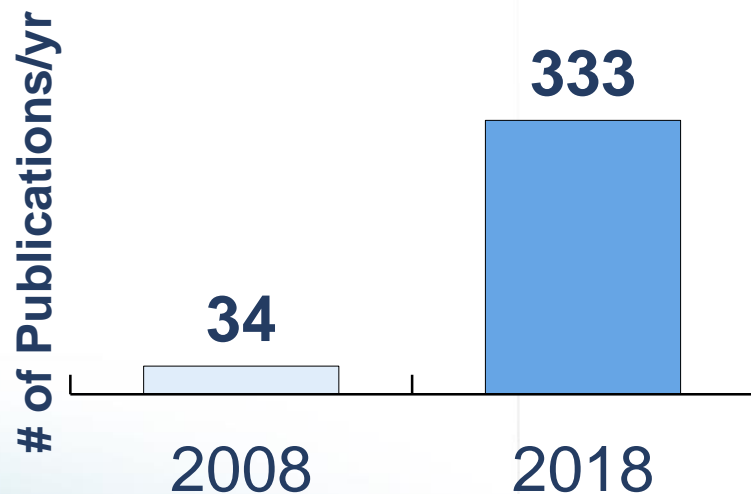


# The CFN has had 10 years of successful nanoscience operations

- We're helping more people with their research every year



- More importantly, we've gotten better at helping people do their work
- In the year just completed, CFN use was cited in 333 publications
- Nearly one paper every single day!



# The CFN 10-year event was a terrific day for everyone

## Activities

- Top-10 Scientific Discoveries
- Lab Tours and Demonstrations
- CFN Image Contest
- “The Glass Menagerie”
- CFN Photo Gallery
- Looking Forward – Our best impacts are still to come



## Event Organizing Committee

Grace Webster  
User Administrator

Pam Ciufu  
CFN Admin

Donna Storan  
Lead CFN Admin

Aaron Stein  
Senior Scientist



# Top 10 CFN Discoveries

- Staff presented posters describing major staff and user accomplishments from our first 10 years
- Timeline of CFN discoveries:
- <https://www.bnl.gov/cfn/decade/timeline.php>



**TOP TEN ACCOMPLISHMENTS**

decade discovery 2018

Single-digit nanometer lithography

CFN User Karl Berggren (MIT), Chuck Black, Vitor Manfrinato, Eric Stach, and Aaron Stein

**TOP TEN ACCOMPLISHMENTS**

decade discovery 2018

Block Copolymer Self-Assembly for Synthesis of High-Performance Nanomaterials

Chuck Black, Antonio Checco, and Atikur Rahman

**TOP TEN ACCOMPLISHMENTS**

decade discovery 2018

Synthesis and characterization of graphene on transition metal substrates

Eli Sutter and Peter Sutter

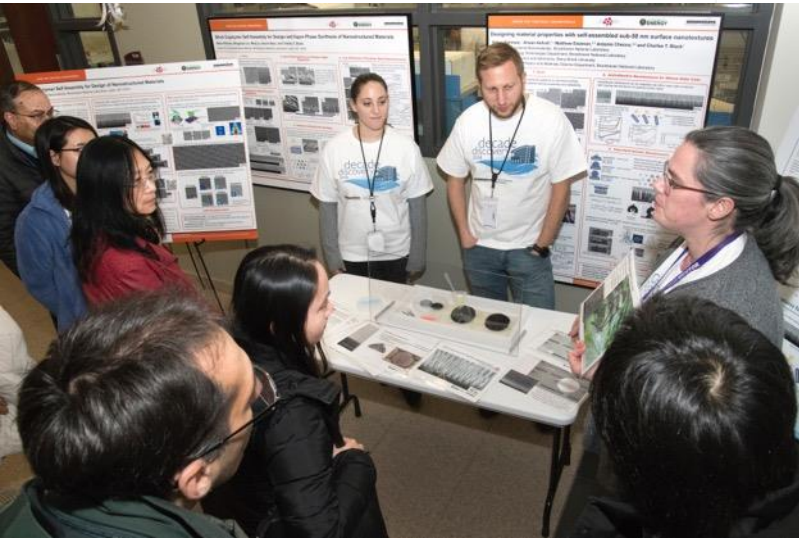
**TOP TEN ACCOMPLISHMENTS**

decade discovery 2018

Atomic-scale understanding of catalytic processes enabled by *in-situ* AP-XPS

Anibal Boscoboinik and Dario Stacchiola

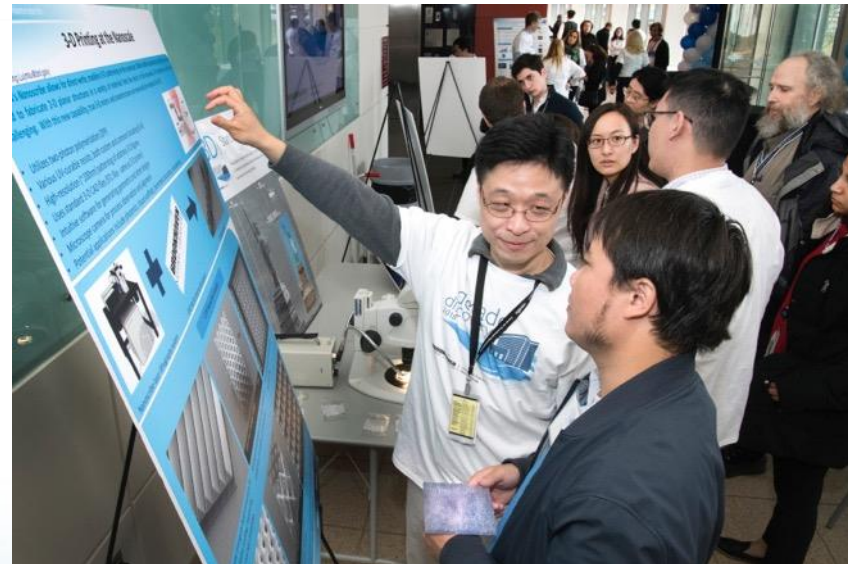
# Lab tours and nanoscience demonstrations



CFN staff Ashley Head, Greg Doerk, and Samantha Nowak demonstrate water-repellent nanotextures

- CFN scientists:
  - Deliver our own world-class nanoscience and
  - Provide expertise in support of research goals of CFN users from around the world

- Communicating CFN science to broad audiences through tours and demos is an important part of the CFN mission



CFN staff Ming Lu explains the nano 3D printing demonstration.

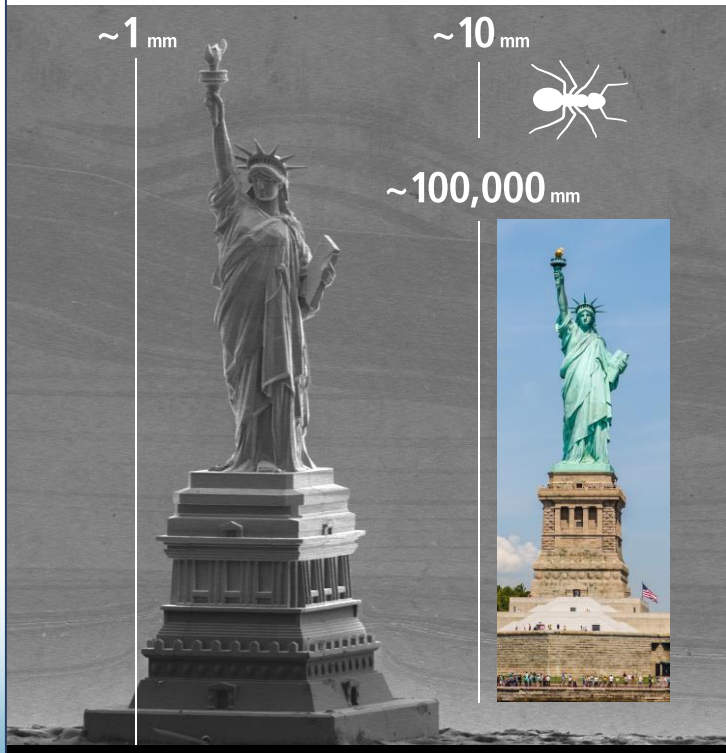


# The CFN supports an instrument for nanoscale 3D printing

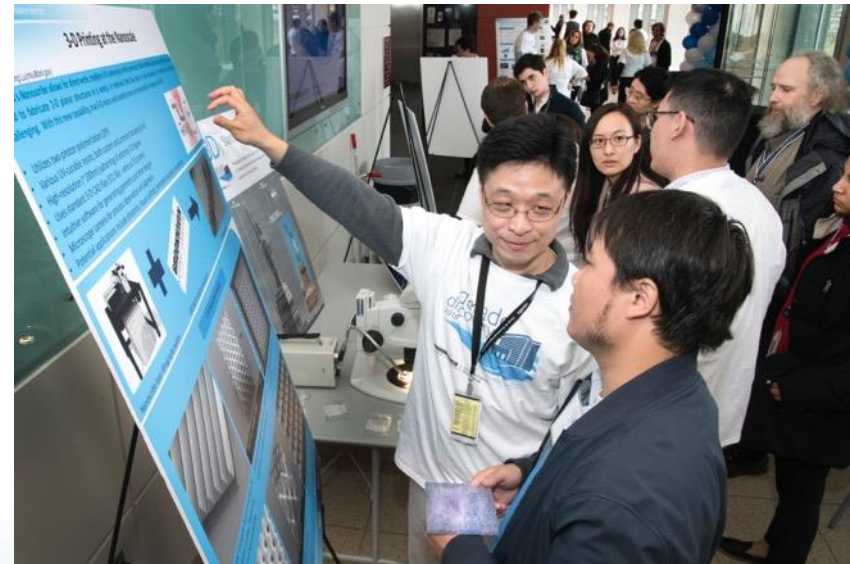
## 3D Printed Statue of Liberty



We use lasers to fabricate custom structures on the nanoscale in 3 dimensions. Applications include manufacturing, biology, and structural and energy materials.



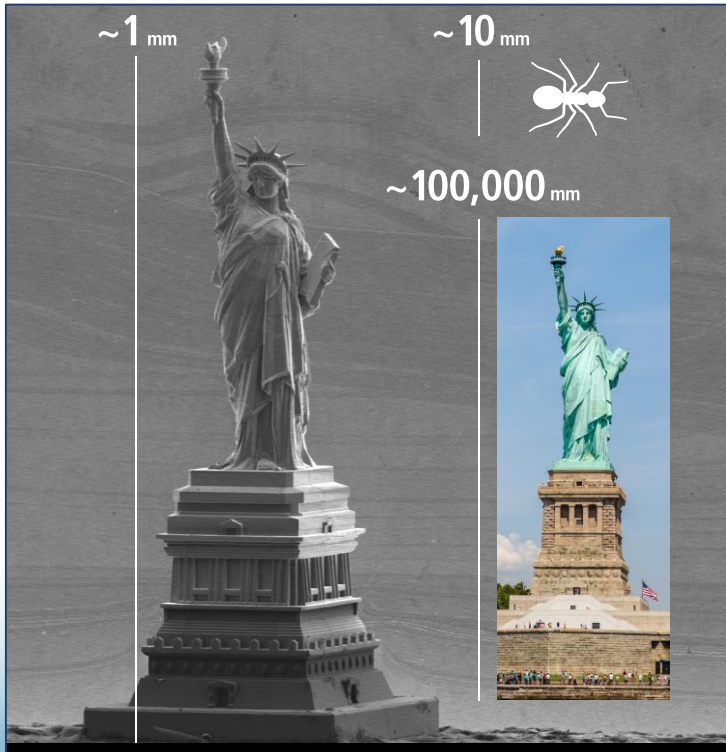
- One popular demonstration is the CFN nanoscale 3D printer



CFN staff Ming Lu explains the nano 3D printing demonstration.

# Energy Secretary Rick Perry visit to BNL, October 26 2018

- Secretary Perry toured CFN labs and printed a nano Statue of Liberty during his visit to BNL





# Annual CFN “Image Challenge” Competition

- Each year the CFN holds an image challenge competition
- Open to entries by CFN users and staff
- Two categories:
  - Scientific Images
  - “My Life at the CFN”
- Winners determined by ballot voting by event attendees
- (Very) small prizes
- Winning images framed and permanently displayed in CFN



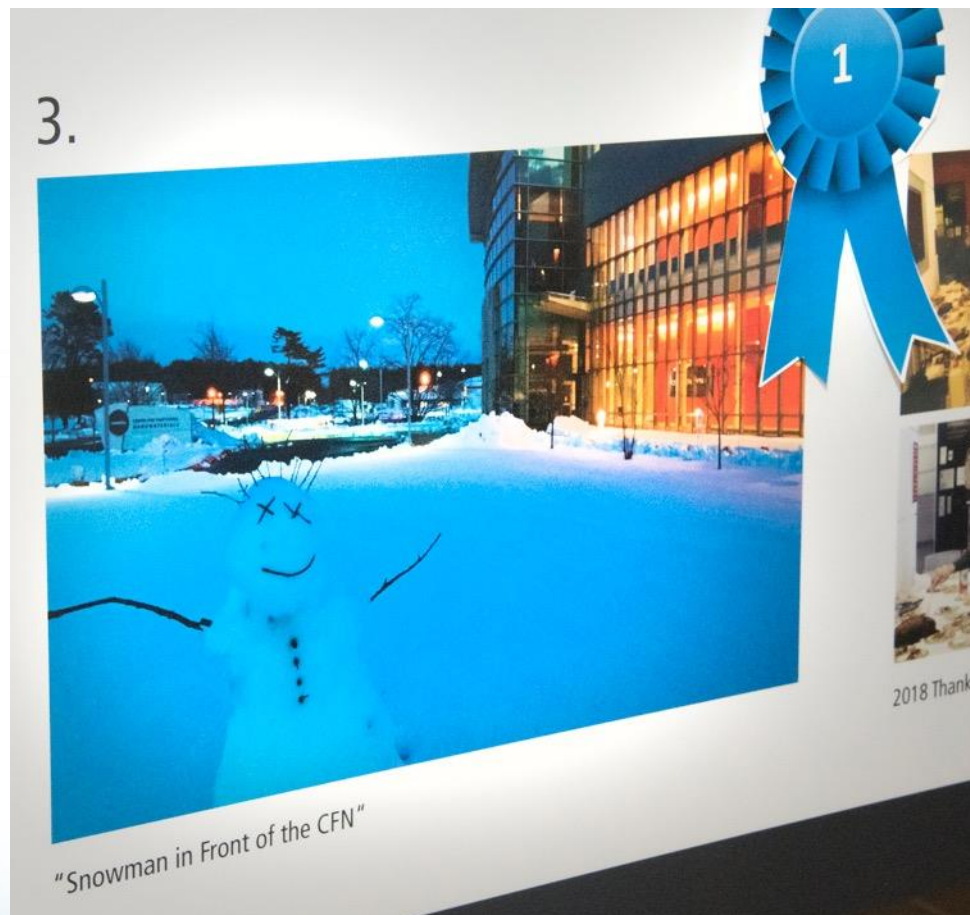
# 2018 CFN "Image Challenge" winners

- Scientific Images



CFN User Andreas Liapis : "Research at the CFN is really flowering"

- "My Life in the CFN"



CFN Staff Gwen Wright: "Snowman in front of the CFN"



# “The Glass Menagerie”

- CFN staff have been collaborating with artists Melissa Clark and Professor Meg Schedel (Stony Brook) to create 3D sculptures using CFN datasets
- Displayed for the first time in BNL at the CFN event
- **The Glass Menagerie** has also exhibited at an event at the Library of Congress in late 2018





# The Glass Menagerie – virtual reality experience

- The Glass Menagerie debuted a virtual reality experience, where the viewer enters the gallery and interact with the sculptures
- Allows the viewer to experience the sculptures across size scales ranging from 'tiny' to highly enlarged
- Virtual reality allows scientists to view and understand their data in new ways



CFN Alum Judy Thompson in the Glass Menagerie



Chuck tries out the virtual reality

# Photo gallery and early CFN contributors



Rick Osgood (former ALD) and Ove Dyling (CFN building project)



Ove, Pam Ciufu, Mike Schaeffer (CFN building project) and Judy Thompson (first CFN lead admin)



Ray Ceruti and Dom Milidantri, with CFN staff Bob Hoade



Chuck with building architect Ahmad Soueid (HDR, Inc.)



# Feedback from event honorees

- “It brought back a lot of my memories starting from the very beginning of the CFN.”
- “Thank you for the recognition of my contributions to the CFN. It was a great day for all! I am looking forward to the next 10 years!”
- **“By far it was the most fun project I worked on in my 25 years at the lab. Yes, it was great seeing old friends and colleagues.”**
- “I enjoyed seeing folks from the “early days” of CFN. It is a huge highlight of my career to have played a part in CFN’s beginnings.”
- **“Thanks for remembering me. It’s rare that any one remembers procurement.”**
- “I felt very privileged to have worked with a very professional project team to make the CFN a successful project! It was a great honor to be present at the 10th anniversary of the CFN and to see so many friends and colleagues!”
- **“...it was a great day, and frankly I found myself feeling surprisingly emotional over the anniversary.”**
- “It was a very nice event — and **really great to see so many old friends and friendly faces.**”



# The CFN has come a long way, but our most impactful work is still to come

- What will these discoveries be?
- How can CFN do better at **creating impact** from our our discoveries, beyond the normal scientific metrics?

## The CFN advances society by understanding/improving materials

- We aspire to participate in delivering the nanomaterial discoveries for the 21<sup>st</sup> century



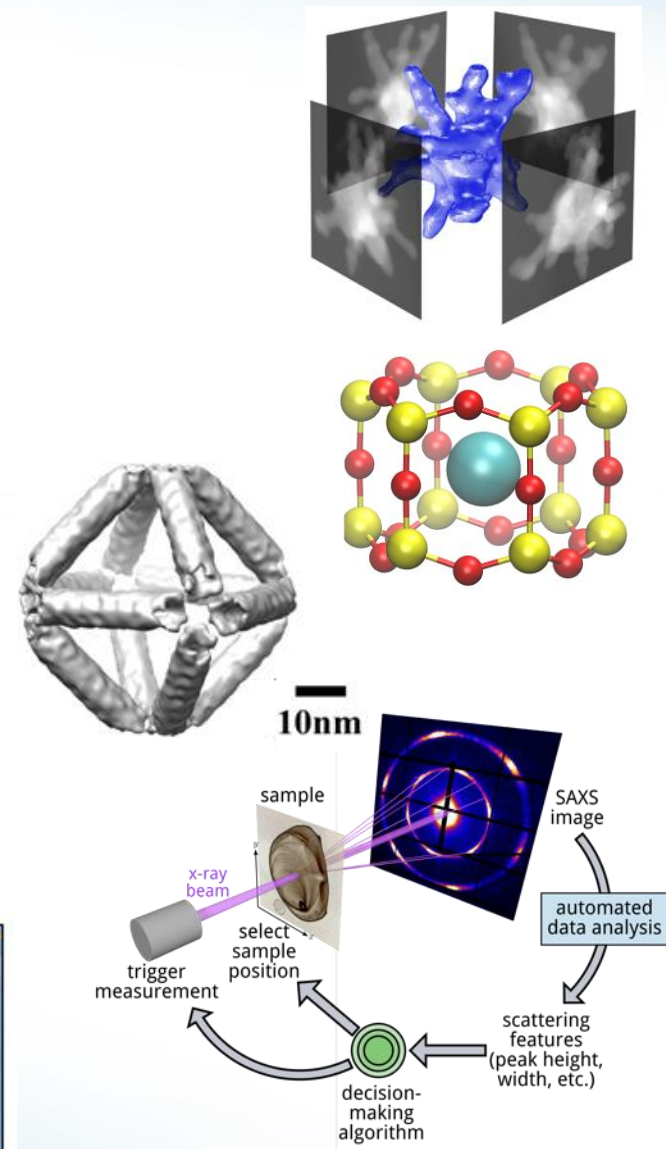
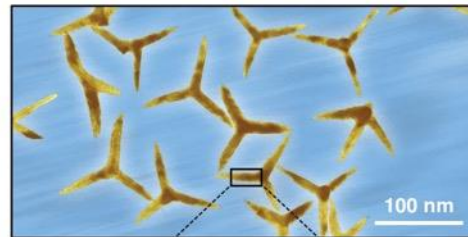
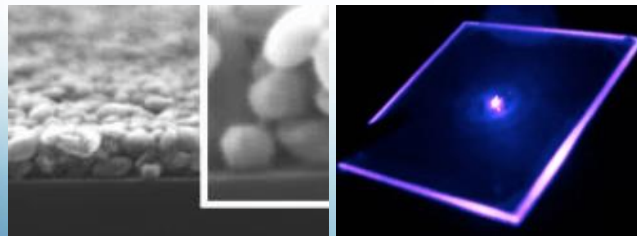
# In 2017, CFN staff members supported users pursuing a wide range of nanoscience projects, including:

- *Operando* Grazing Incidence Small-Angle X-ray Scattering/X-ray Diffraction of Model Ordered Mesoporous Lithium-Ion Battery Anodes (User: Brian Vogt, Univ. Akron)
- Colorful Polymer Solar Cells Employing an Energy Transfer Dye Molecule (User: André Taylor, Yale)
- Reactions of SO<sub>2</sub> on Hydrated Cement Particle System for Atmospheric Pollution Reduction (User: Alexander Orlov, Stony Brook)
- Neutron Irradiation and High Temperature Effects on Amorphous Fe-Based Nano-Coatings on Steel (User: Nik Simos, BNL)
- The Third Ambient Aspirin Polymorph (User: Bart Kahr, NYU)
- The Structure of Glycine Dihydrate: Implications for the Crystallization of Glycine from Solution and Its Structure in Outer Space (User: Chunhua (Tony) Hu, NYU)
- Electrical Impedance Microflow Cytometry with Oxygen Control for Detection of Sickle Cells (User: E. Du, Florida Atlantic Univ.)
- Innovative Point-of-Care (POC) Micro Biochip for Early Stage Ovarian Cancer Diagnostics (User: Eon Su Lee, NJIT)

# CFN is making nanoscience discoveries with potential to improve our world

For example:

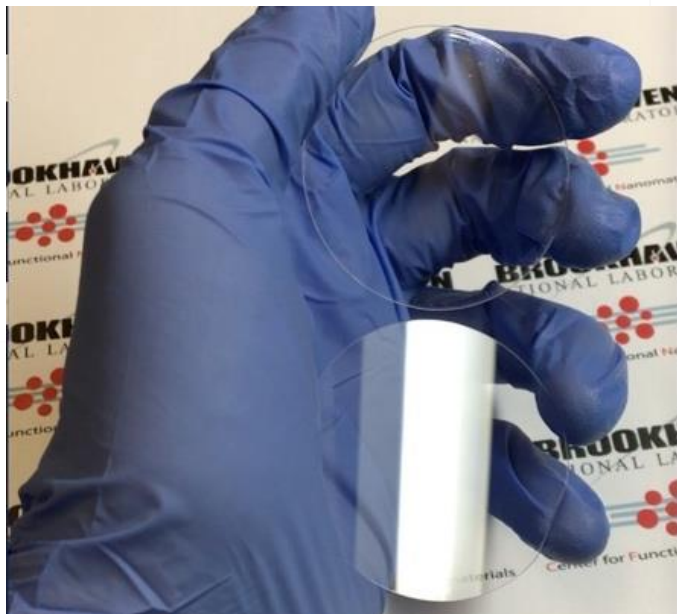
- Antireflection nanotextures
- Water-repellent nanotextures
- Surfaces for trace molecule detection
- Materials for capture of rare gases
- Oil-absorbing sponges for environmental remediation
- Cheap lasers (~1¢) from nanoparticles
- Ultrasensitive biomolecule detection





# Can you see the Invisible Glass?

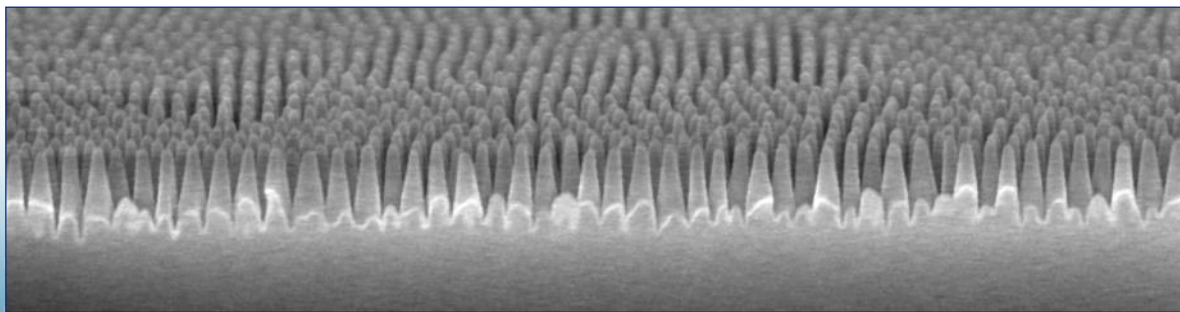
- CFN method of 'synthesis by assembly' used to nanostructure glass surfaces to eliminate reflections



2016 R&D100 Award Winner



2018 Grand Prize Winner



# Can you see the Invisible Glass?

- CFN method of 'synthesis by assembly' used to nanostructure glass surfaces to eliminate reflections



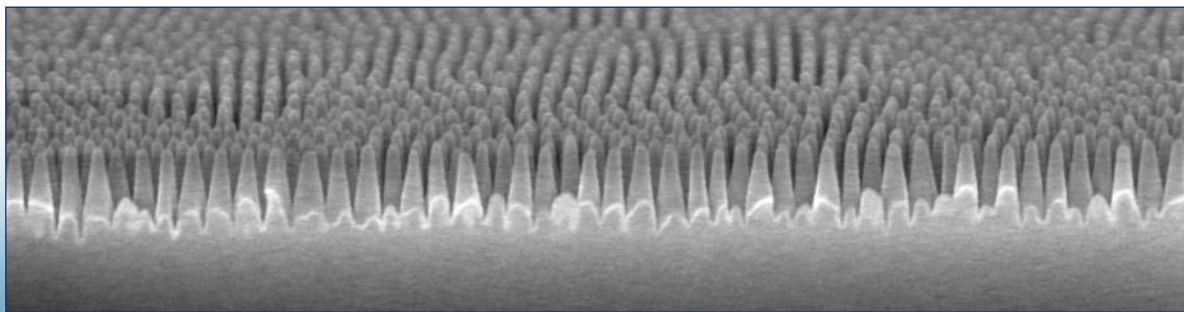
2016 R&D100 Award Winner



2018 Grand Prize Winner

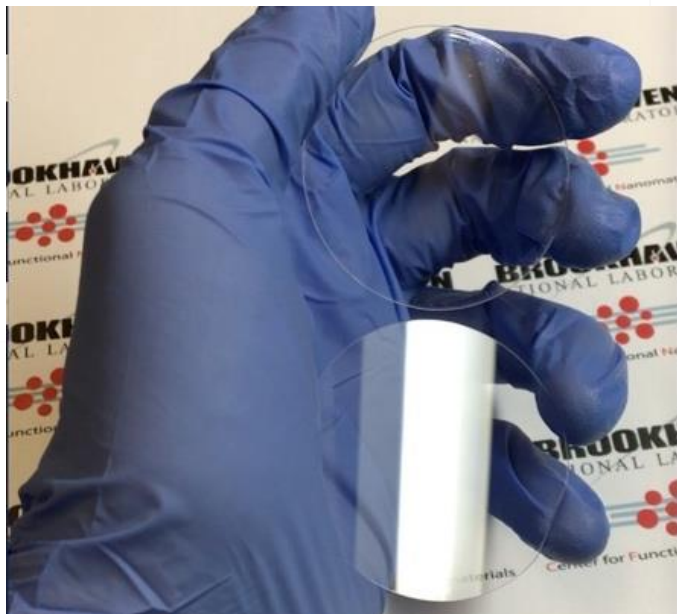


- Our challenge (and opportunity) is to work towards impacts beyond the basic discovery science

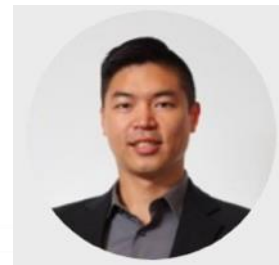


# Can you see the Invisible Glass?

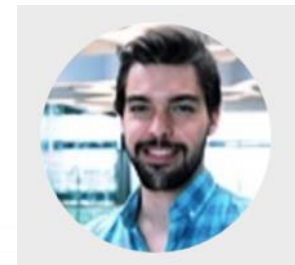
- CFN method of 'synthesis by assembly' used to nanostructure glass surfaces to eliminate reflections



Bio-Inspired Light Management

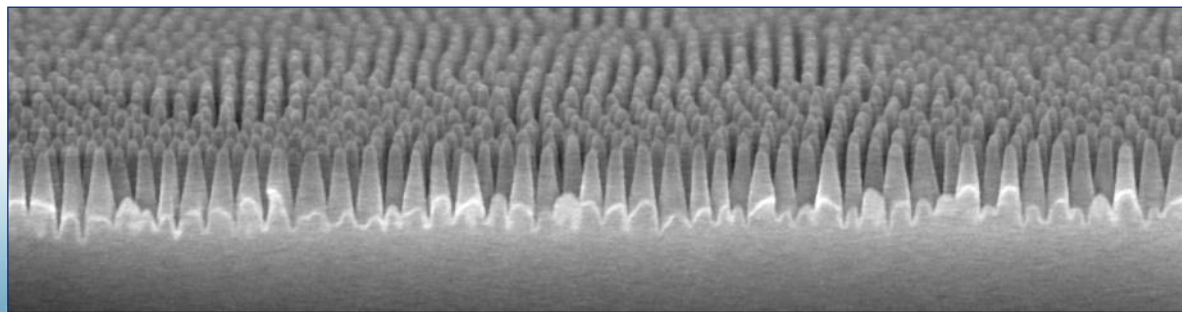


Calvin Cheng



Mat Massicotte

- Start-up venture will commercialize self-assembly based nanotextures for consumer electronics





# Partnerships will always underlie CFN success

- We have had an excellent first 10 years of growth, building relationships with a highly productive nanoscience user community
- Last December, we held a happy event, recognizing our accomplishments and looking to the future
- CFN has an important opportunity to impact society through its nanomaterial discoveries
- The Long Island community is an important CFN partner
- (Please come visit us any time!)

