

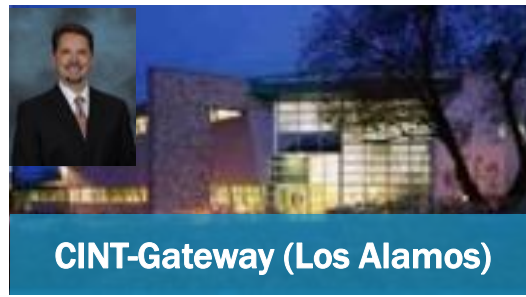
# Center for Integrated Nanotechnologies (CINT)

We utilize modeling, synthesis, characterization, and nanofabrication to create advanced materials for integration into technologies impacting national priorities

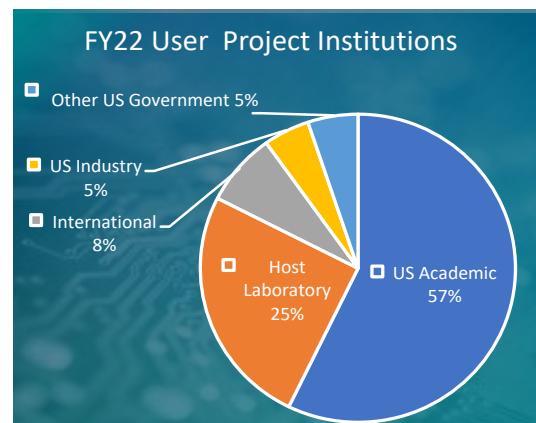
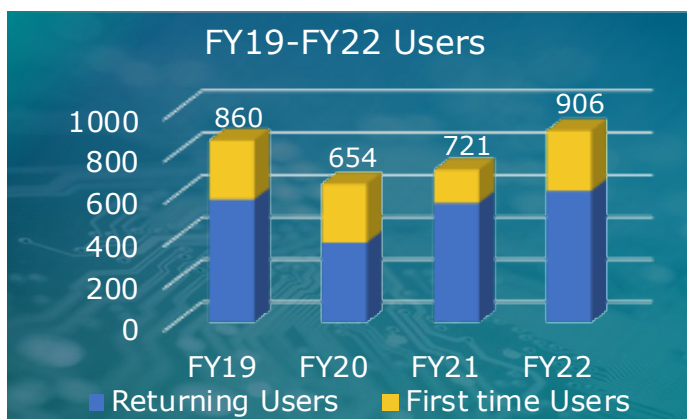


Jeff Nelson  
Director

Adam  
Rondinone  
Co-Director



We have a vibrant and growing user community

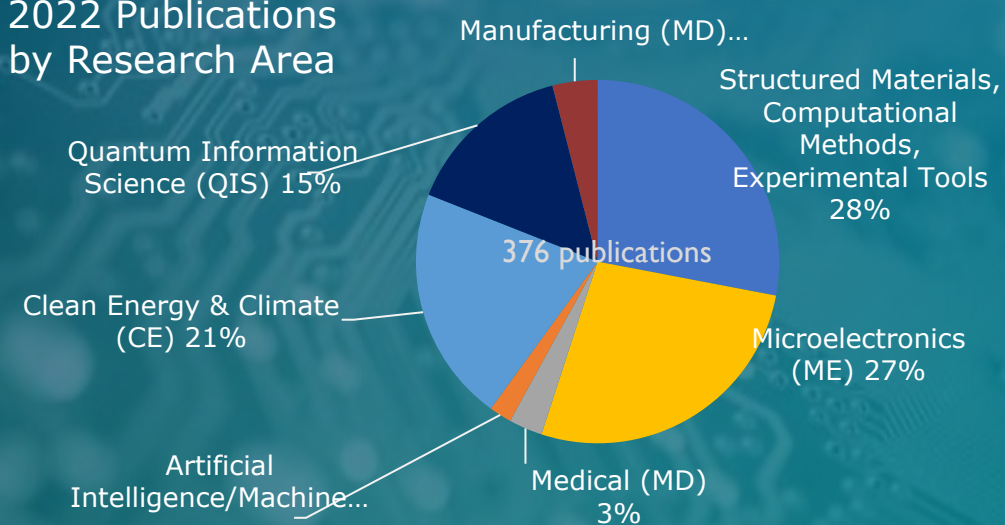


## Scientific Thrusts

- In-Situ Characterization and Nanomechanics
- Nanophotonics and Optical Nanomaterials
- Quantum Materials Systems
- Soft, Biological, and Composite Nanomaterials

*Thrusts align with strengths of host laboratories, amplifying capabilities and expertise for our users*

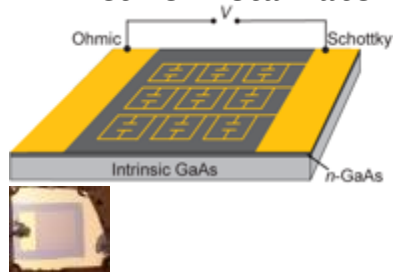
## 2022 Publications by Research Area



# Scientific Impact Drives User Community Engagement – “Top Three”

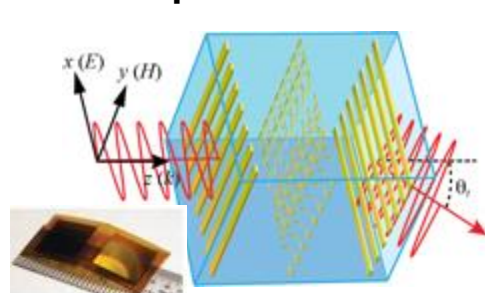
## Metamaterials / Metasurfaces Photonics@ CINT

### Active metamaterials



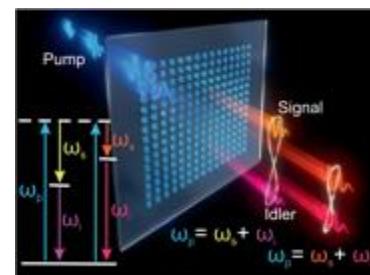
Nature, 2006

### Flat optics – metasurfaces



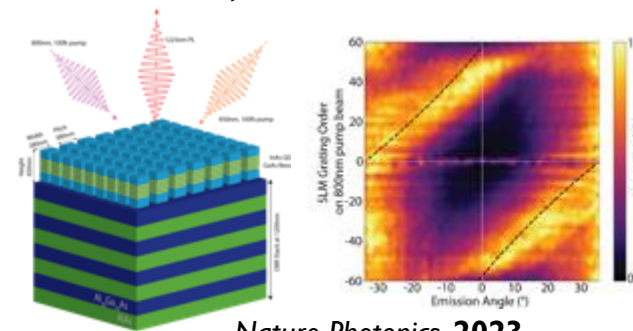
Science, 2013

### Quantum metasurfaces



Science, 2022

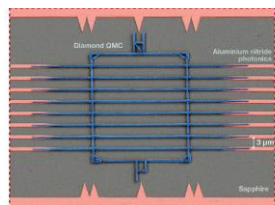
### Metasurfaces, incoherent emission control



Nature Photonics, 2023

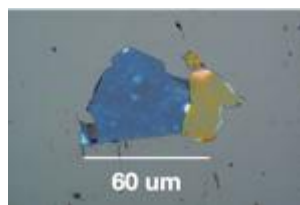
## Quantum Information Sciences @ CINT

### Nanoimplantation of Quantum Defects



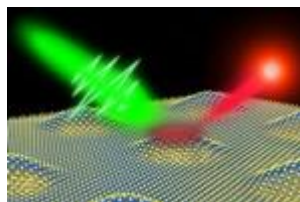
Nature, 2020

### Diamond NV for Sensing



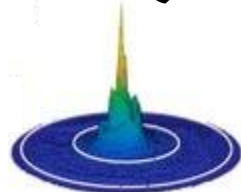
APL, 2022

### 2D Quantum Emitters



Nature Commun., 2021

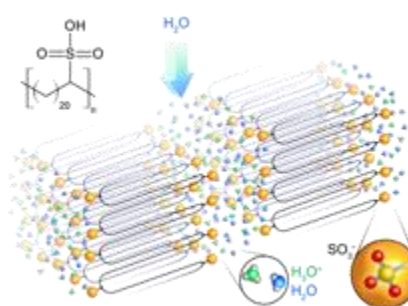
### Precision Single Photon QDs



APL Photonics, 2021

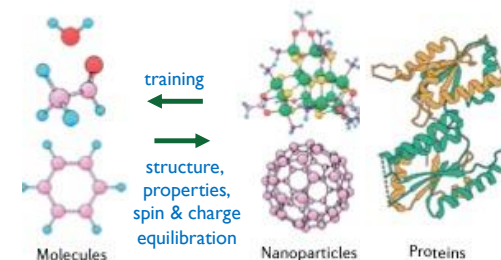
## Computational Materials Science @ CINT

### Molecular dynamics for soft materials properties



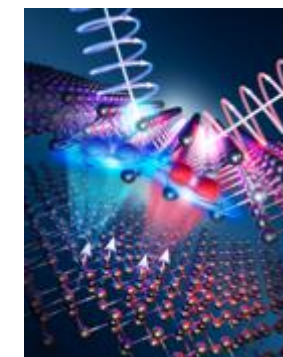
Nature Materials, 2018

### Neural network models for chemical processes



Nature Commun., 2021

### Electronic structure for exotic states of quantum materials

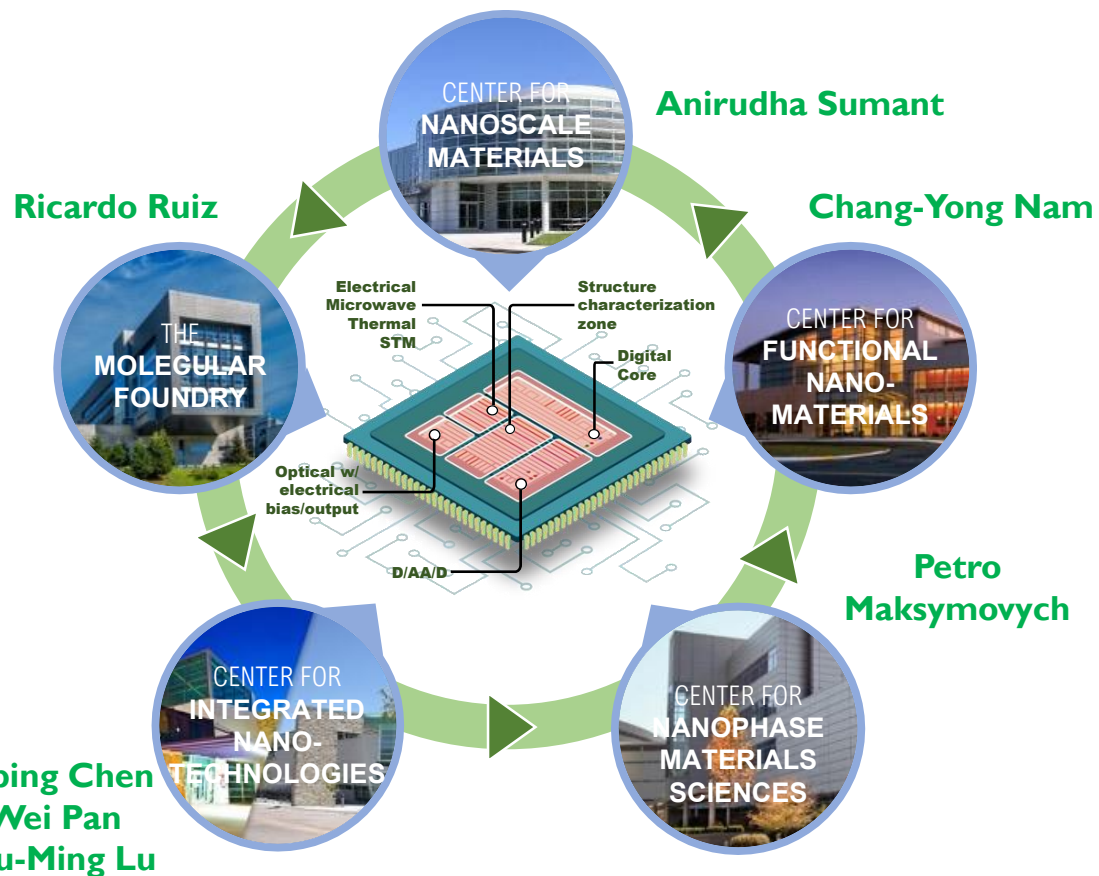


Nature Materials, 2023



# NSRC Working Group on Microelectronics

Collective resource to accelerate *CHIPS and Science Act* innovation and economic impact



## Industry and University Research Needs

- Metrology, Modeling and AI for 3D Heterogeneous Integration
- Materials Synthesis
- Integration of Non-Conventional Materials and Device Architectures
- Tools for Next-Generation Lithographic Patterning
- Advanced In-Situ / Operando Characterization

## Combined Capabilities, Expertise, and Facilities

- **40,000 sq. ft. of flexible, fast-turn cleanrooms** for nanofabrication and integration of early stage materials, devices and architectures
- More than **100 materials synthesis laboratories** for inorganic, organics, and hybrid composites
- More than **30 unique measurement capabilities** for *metrology, property, performance, and in-situ / operando studies*
- **Atomic to microscale modeling tools**, including AI/ML for Lab to Fab correlations
- **Portal to other DOE** Facilities and User Facilities



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# CINT serves a diverse, equitable, and inclusive user community

113 (38%) of the 301 US Academic projects are from MSIs

FY23Q1 CINT Projects from Minority Serving Institutions



## Strengths of the user community

- Strong regional support of MSI users
- Sustained support for existing users
- Healthy growth of new users
- Balance of user projects from academia, government, and industry
- Regional small business well represented in user community

## To strengthen our user community, we need to-

- Increase institutional growth
- Expand access for HBCUs
- Grow large-industry user base (contact sport)
- Improve remote access of data & research equipment

## CINT Initiatives

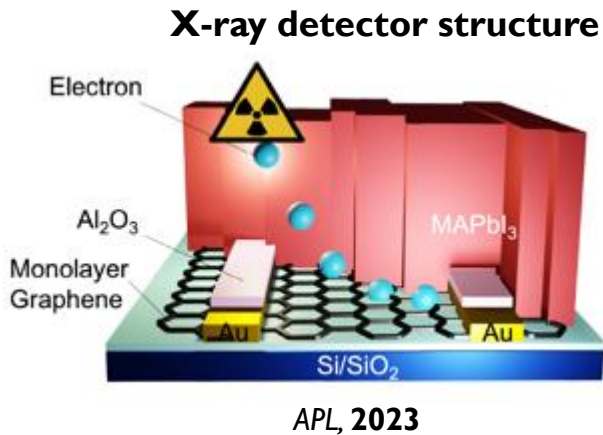
- Investing operational funds and host laboratory funding opportunities to expand access to data & equipment
- Engaging broadly in host laboratory DEI efforts
- Outreach at technology-focused conferences and events
- Engaging with regional state and local economic development groups- *Chips and Science Act* is an excellent opportunity
- Sponsor undergraduate and graduate summer & year-round interns through internal host laboratory LDRD programs
- Increasing outreach and visibility through LinkedIn and other social media platforms



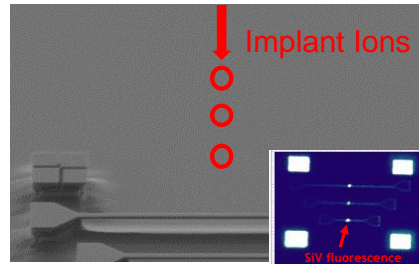
# CINT's NSRC recapitalization investments will position our user community to advance microelectronics, quantum, and clean energy S&T

Microelectronics, quantum devices, and clean energy science & technologies rely on the ability to -

- synthesize *advanced and complex thin films*,
- *fabricate* those films to demonstrate new science and innovative technologies

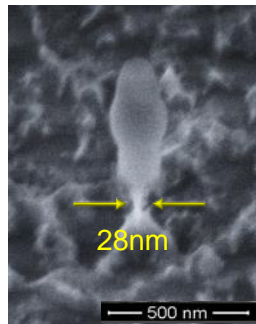


## Diamond nanobeams



Science, 2016

## Integration of detachable diamond-based quantum sensors



Courtesy Keshab Sapkota, CINT, 2023

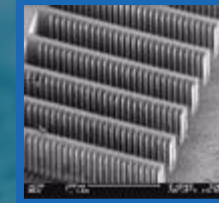
## Next-Generation Capabilities for Nanoscience

- *Expanding the Limits of Nanofabrication*
- *Accelerating Nanoscale Materials Discovery and Design*
- Decoding Nanoscale Dynamics and Heterogeneity

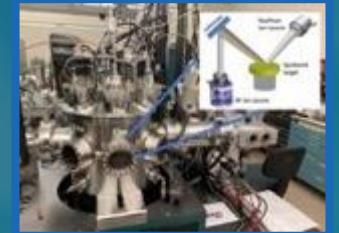
### Advanced III-V Heteroepitaxy



### Advanced Etch and Lithography



### Dual Ion Beam Sputter System



## Value proposition to the user community

- Provides users access to difficult-to-synthesize materials and heterostructures
- Benefits users who work to develop new materials but cannot fabricate them at their home institutions



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