

# CINT

SAND2017-1458PE

The Center for Integrated Nanotechnologies

*Nanomaterials*

*Integration*

*A U.S. DOE Nanoscale Science Research Center*

## CINT: A National User Facility for Nanoscience Research (Free Science!)

**Sean J. Hearne, Ph.D.**  
Senior Manager – CINT Sandia  
[sjhearn@sandia.gov](mailto:sjhearn@sandia.gov)

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



Sandia  
National  
Laboratories



# CINT is a DOE Office of Science National User Facility

"A DOE/SC user facility has unique world-class research capabilities and technologies which are available broadly to science community worldwide from universities, industry, private laboratories, and other Federal laboratories for work that will be published in the open literature."



## The DOE/SC nanoscience centers:

- Are defined by a scientific field, not specific instrumentation.
- NSRC staff support user projects and conduct original research.
- Capabilities involve expertise, hardware and software.
- Users access Synthesis, Fabrication, Characterization and Theory capabilities.



# CINT is a LANL/SNL partnership to create a National resource for nanomaterials integration

## CINT History:

- 2001 DOE approves CINT proposal
- 2002 Sandia / Los Alamos MOU
- 2003 Jump-start operations
- 2004 Ground breaking
- 2006 Buildings dedicated
- 2007 Full operations

## CINT Today:

- 4 Science Thrusts, 1 leadership team
- 2 Facilities (total 130,000 gsf)
- 51 scientists & technologists
- 32+ post-docs & students
- 500+ users engaged in 200+ projects
- 270+ publications annually
- Peer-reviewed user proposal process
- No-fee for pre-competitive research
- Full cost recovery for proprietary research

## Core Facility



## Gateway Facility





# Differentiator : Nano-Integration

## Nano-integration can take many forms

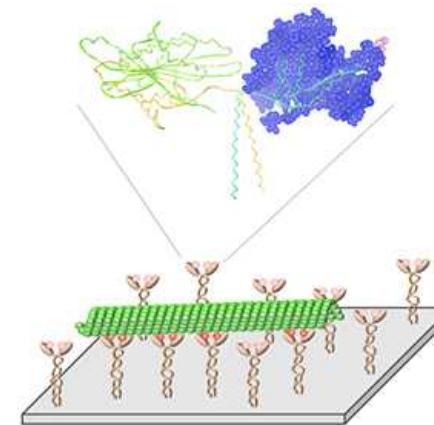
### Mechanical strengthening from incorporation of nanotubes



Carbon nanotubes in 17<sup>th</sup> Century Damascus steel

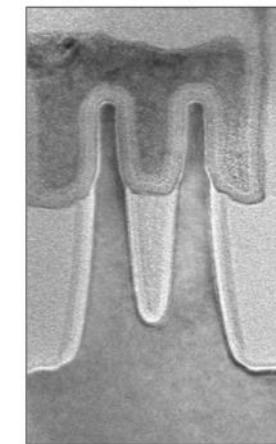
Reibold, et. al, Nature 444, 286 (2006)

### Collective behavior of biological systems



kinesin nanomotors to transport microtubules and nanoparticle payloads

### Nano-scale patterning to build hierarchical structures



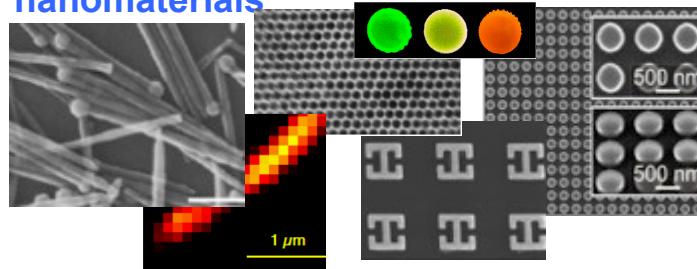
Intel 14nm Broadwell CPU (2015) ~100 Atoms



# CINT has four scientific thrusts that steward capabilities

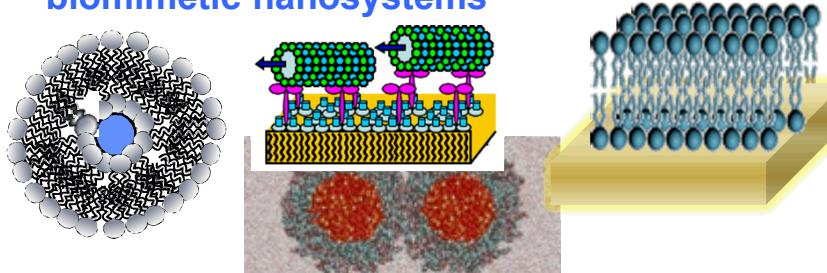
## Nanophotonics & Optical Nanomaterials (NPON)

Synthesis, excitation and energy transformations of optically active nanomaterials



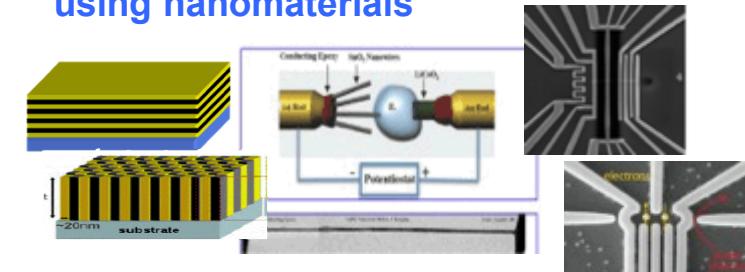
## Soft, Biological, & Composite Nanomaterials (SBCN)

Solution-based nanomaterials synthesis and assembly of soft, composite and artificial biomimetic nanosystems



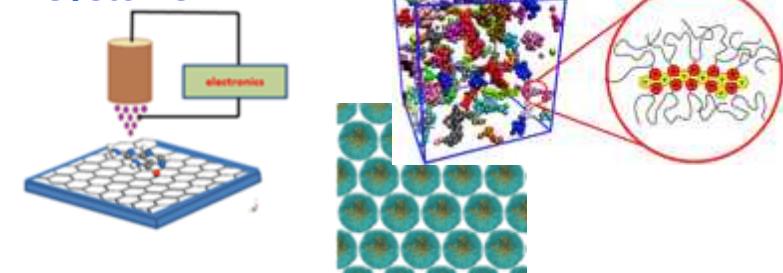
## Nanoscale Electronics & Mechanics (NEM)

Control of electronic transport, wavefunction, and mechanical coupling using nanomaterials



## Theory & Simulation of Nanoscale Phenomena (TSNP)

Assembly, interfacial interactions, and emergent properties of nanoscale systems



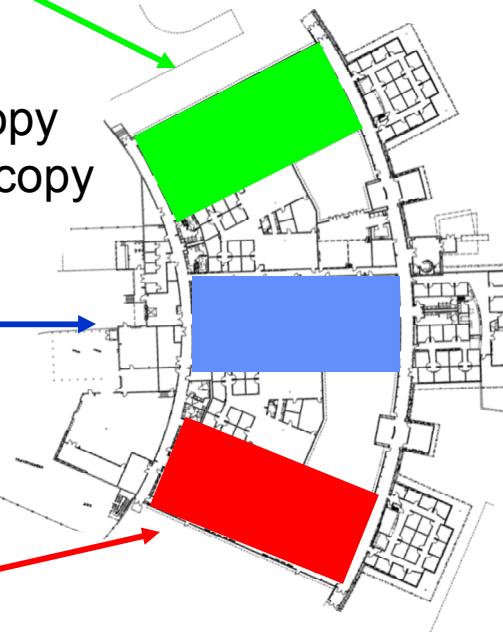


# CINT has capabilities for synthesis, characterization and integration

## Characterization Wing

- TEM, SEM
- Low Temp Transport
- Scanning Probe Microscopy
- Ultra-fast Laser Spectroscopy

## Core Facility



## Synthesis Wing

- Molecular Beam Epitaxy
- Chem & Bio labs
- Molecular films

## Integration Lab

- E-beam lithography
- Photolithography
- Deposition & Etch
- SEM/FIB

## Gateway to Los Alamos

- NSOM, AFM
- Environmental SEM
- Nano-indenter
- Pulsed Laser Dep.
- Ultra-fast Spectroscopy
- Computer Cluster
- Visualization Lab

