

Welcome to the 2nd Annual NNCI Conference



National Nanotechnology
Coordinated Infrastructure



Welcome to the NNCI Advisory Board



Dion Dionysiou
U Cincinnati



Reggie Farrow
NJIT



Andrew Greenberg
U Wisconsin



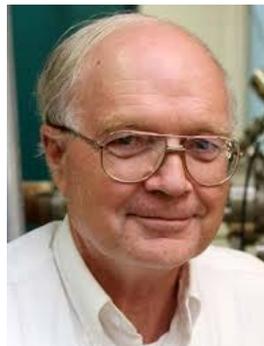
Elaine Hubal
EPA



Angelique Johnson
Entrepreneur



Joe Magno
NC COIN



Richard Osgood
Columbia U



Kurt Petersen
Entrepreneur



Andreas Roelofs
Los Alamos NL
CINT Director



Ken Wise
U Michigan

Program Components

- Presentations from the Coordinating Office
 - Overview, Computation & Modeling, Social & Ethical Implications, Education & Outreach
- Site Reports in 4 Site Report Panels
 - Redefining Traditional Users
 - Resource Allocation and New Equipment
 - Future Research Directions
 - New Education & Outreach Concepts
- Invited Speakers
 - Prof. Mehdi Javanmard, Rutgers University
 - Prof. Eric Stach, University of Pennsylvania
 - Dr. Andrew Fung, CMC Microsystems, Canada
- Breakout Sessions & Reporting

Breakout Sessions

Breakout Session 1

10/17, 9:20-10:10PM

Facility Management & Operations

Bernd Frühberger, SDNI

Diversity

Jacob Jones, RTNN

Advisory Board Meeting

Facility Tours

Breakout Session 2

10/17, 10:10-11:00AM

New Business Development Concepts

Bill Wilson, CNS

Training Program & Workshops

Noah Clay, MANTH

Advisory Board Meeting

Facility Tours

Program Components (cont.)

- Group Photo (10/16, 11:30-11:45)
- NNCI Site Directors Meeting with CO (10/17, 7:30-8:30)
- Advisory Board Meeting (10/17, 9:20-11:00)
- Facility Tours (during breakout sessions)

- Education and Outreach Meeting (10/17, 8:00-12:00)
- Social and Ethical Implications Meeting (10/17, 1:30-5:30)



***National Nanotechnology
Coordinated Infrastructure (NNCI)***



National Nanotechnology
Coordinated Infrastructure



Outline

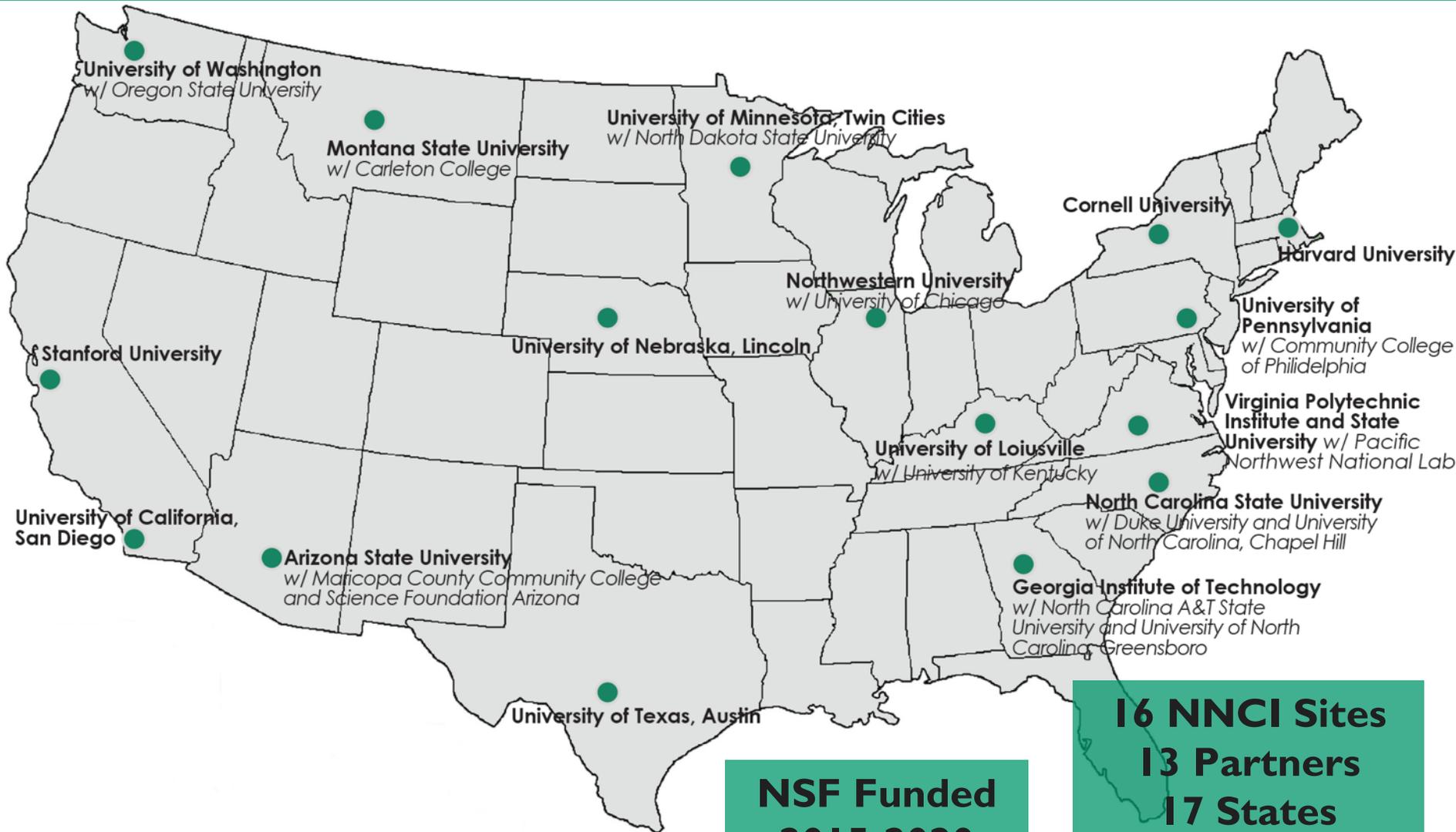
- NNCI Brief Overview
- NNCI Year 2 Facilities Usage
- NNCI Coordinating Office (NNCI CO)
 - Organization
 - Initiatives: Webpage, Sub-Committees & Working Groups, User Survey, NNCI Video, NNCI Conference, Annual Reporting
- Questions & Discussion

NNCI Associate Director Reports

- NNCI Computation & Modeling
Dr. Azad Naeemi
4:45-5:00
- Societal & Ethical Implications
Dr. Jamey Wetmore
5:00-5:15
- Education & Outreach
Dr. Nancy Healy
5:15-5:30



National Nanotechnology Coordinated Infrastructure (NNCI)



**NSF Funded
2015-2020
\$81M total**

**16 NNCI Sites
13 Partners
17 States
67 Facilities
>2000 Tools**

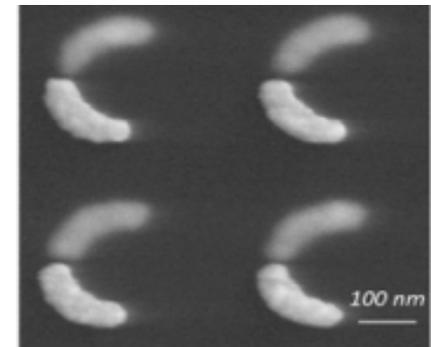
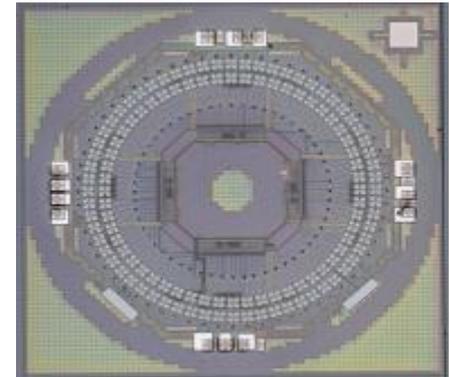
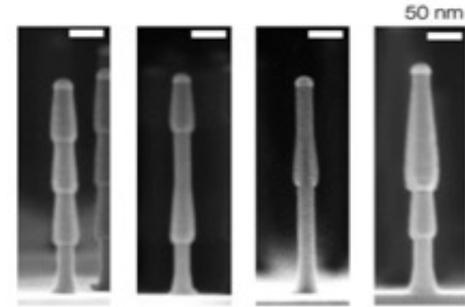
National Nanotechnology Coordinated Infrastructure (NNCI) Goals

- Provide open access to **state-of-the-art nano-fabrication & characterization facilities** and their tools across US and **staff expertise**
- Use these resources to support **education & outreach (E&O)** as well as **societal & ethical implications (SEI)** in/of nanotechnology
- **Network approach to make whole more than the sum of its parts**



How are these Facilities used today?

- Top-down (lithography defined) and bottom-up (material synthesis) nanofabrication
- Nanoscale imaging and metrology
- Range from materials & processes to complex devices, systems & their applications
- Large variety of disciplines: nanomaterials, nanoelectronics; MEMS/NEMS; sensors; energy; life sciences & health care; environmental & geosciences; food & water; IoT; defense; ...
- Education, training, workforce development & outreach



NNCI Year 2 User Statistics (10/2016-03/2017)

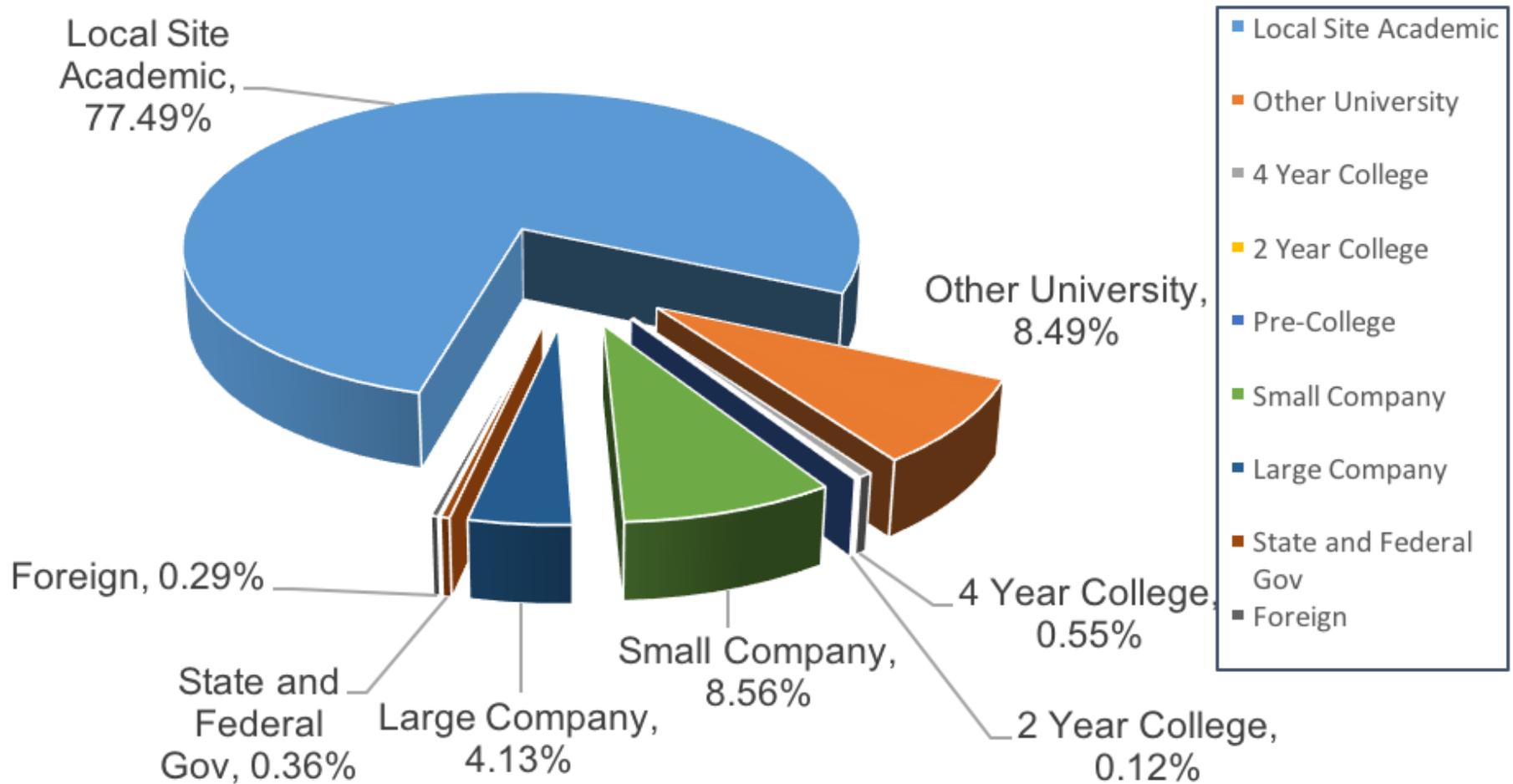
	NNCI Network	NNCI Sites Mean (Min - Max)
Unique Facility Users	9,050	566 (111 - 1,176)
Unique External Users	1,990 22.5%	124 (17 - 407) 22.6% (7.4% - 44.1%)
Industry Users	1,122	70 (11 - 155)
External Academic Users	868	54 (3 - 302)
Average Monthly Users	4,753	297 (41 - 711)
Users Trained	2,330	146 (12- 324)
Facility Hours	434,350	27.1k (2k - 83k)
External Facilities Hours	89,268 20.6%	5,579(153 - 22,765) 20.2% (1.5% - 45.1%)
Hours/User	48	45 (18 - 90)
User Fees	\$17.6M	\$1.1M (146k - 3.25M)

NNCI Year 1 User Statistics

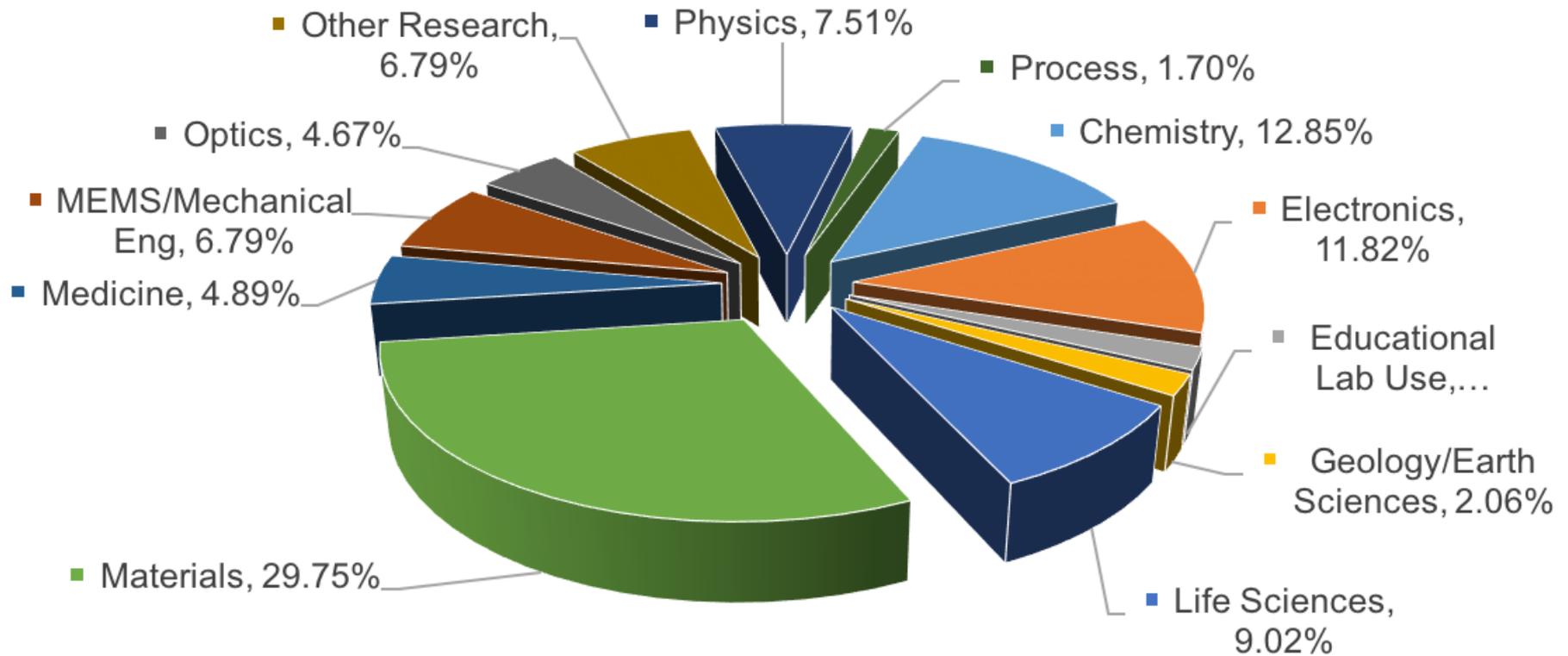
	Year 1 (12 months)	Year 2 (6 months)	
Unique Facility Users	10,675	9,050	
Unique External Users	2,561 24.4%	1,990 22.5%	
Industry Users	1,410	1,122	
External Academic Users	1,151	868	
Average Monthly Users	4,427	4,753	 <input type="checkbox"/>
Users Trained	4,116	2,330	 <input type="checkbox"/>
Facility Hours	>900,000	434,350	
External Facilities Hours	>170,000 20.2%	89,268 20.6%	 
Hours/User	85	48	 <input type="checkbox"/>

In Year 1, >200 academic institutions, >700 companies, >40 government & non-profit organizations, and >35 international entities

Users By Affiliation



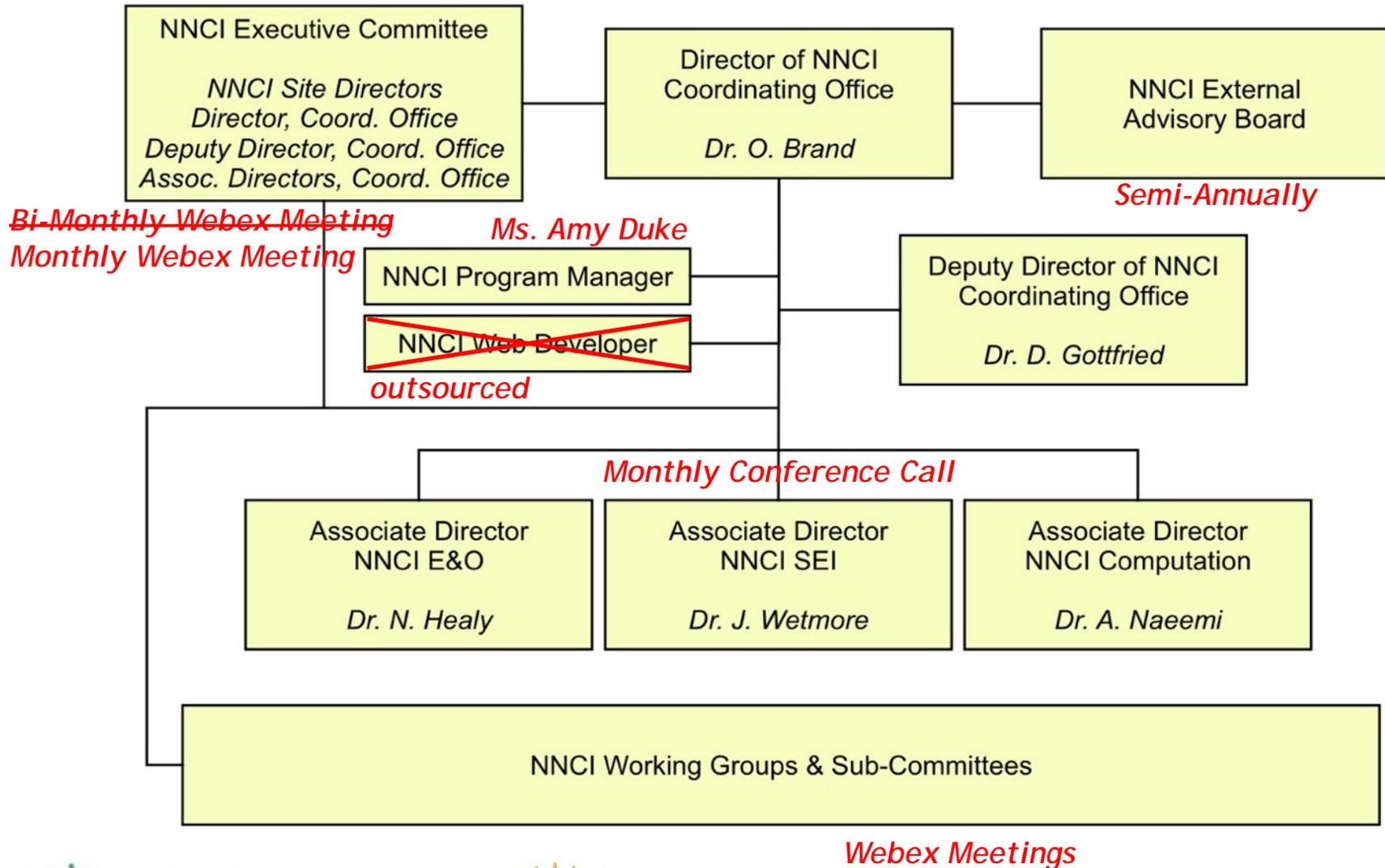
NNCI User Data – Users by Discipline



Overall Coordinating Office Objectives

1. Facilitate and promote the NNCI network, rather than trying to direct it
2. Use creative means to incentivize the sites for participation in network activities
3. **Assist in making the network more than the sum of its parts**

CO Organizational Structure





Tools

More than 2000 tools are available to NNCI users.

[SEARCH FOR TOOLS](#)

NNCI Website – Phase 2 (CY 2017)

- Improved homepage map
- Improvements to site pages
- Improved searching for tools/experts
- New navigation for education/SEI content
- New Nanooze page
- Improved contact forms
- Website search capability

- In Progress: Additional resources content
 - Recipes with rating system
 - Technical reports
- In Progress: Private pages for working group activity

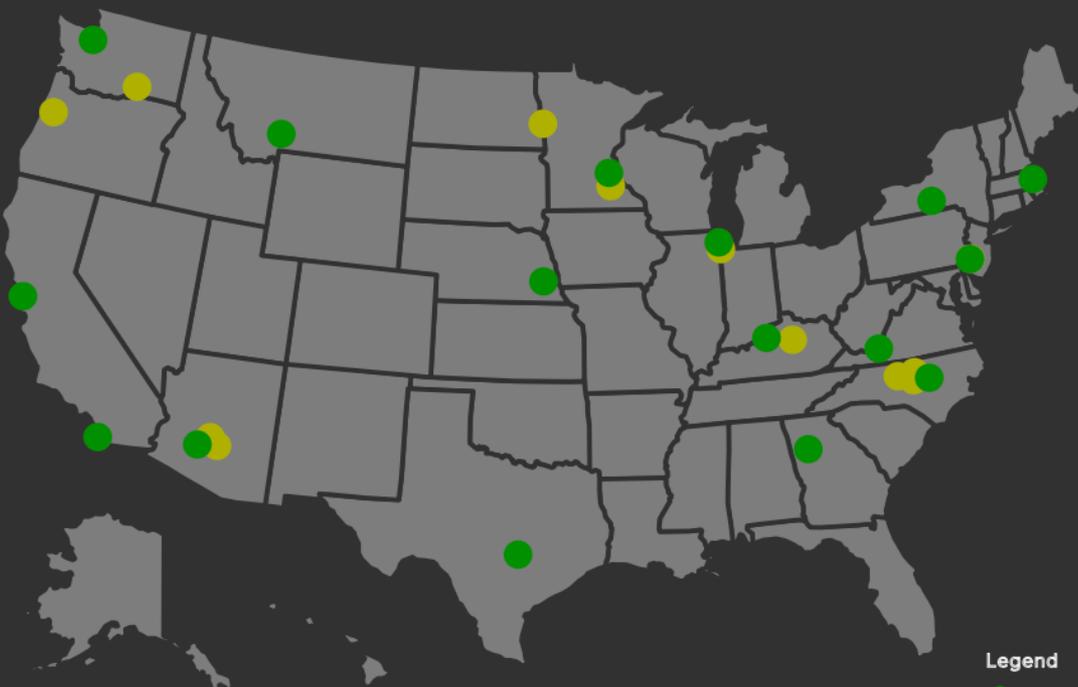
NNCI Sites

What is the NNCI?

The [National Science Foundation \(NSF\)](#) supports 16 user facility sites, their affiliated partners, and a coordinating office as the National Nanotechnology Coordinated Infrastructure (NNCI). The NNCI sites provide researchers from academia, small and large companies, and government with access to university user facilities with leading-edge fabrication and characterization tools, instrumentation, and expertise within all disciplines of nanoscale science, engineering and technology.

LEARN MORE

- Select a Site -



400-500 visitors per week
2/3 of which are new visitors

Sub-Committees

- **Diversity**
Mike Hochella (NanoEarth) - Lead
- **Metrics**
Stephen Campbell (MINIC) - Lead
- **National and International Relations**
Vinayak Dravid (SHyNE) - Lead
- **New Equipment and Research**
Kevin Walsh (KY MMNIN) - Lead
- **Entrepreneurship**
Mark Allen (MANTH) - Lead
- **Workforce Development**
Trevor Thornton (NCI-SW) - Lead
- **Building the User Base**
Nan Jokerst (RTNN) – Lead

“Subcommittees of the Executive Committee will be formed to tackle high-level issues related to the NNCI network as a whole”

Diversity Sub-Committee (Lead: M. Hochella)

1. How can NNCI increase the diversity of users and participants in education and SEI activities?

- Lower bar for entry for users classified as adding to diversity
- Offer cost assistance
- Offer internships
- Provide a Spanish homepage button to click
- Advertise on our homepages with videos
- Work with local college diversity offices

2. What forms of marketing and recruitment can we use to reach a diverse user population?

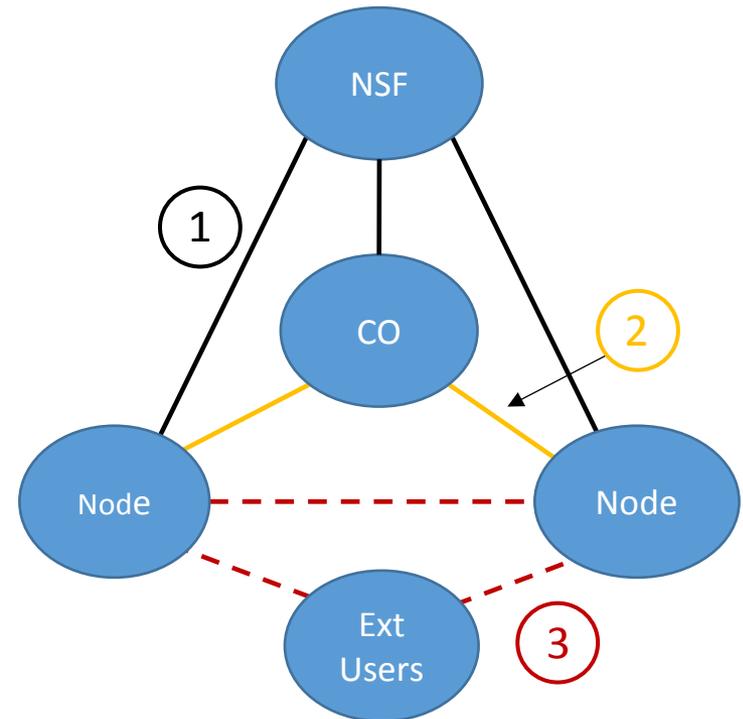
- Utilize personal visits to schools that provide diverse users (e.g. HBCUs)
- Host targeted workshops
- Utilize societies that serve under-represented demographic groups



Metrics Sub-Committee (Lead: Stephen Campbell)

Reviewed three types of metrics:

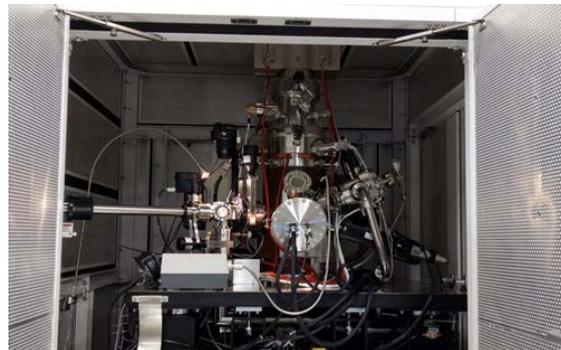
1. Nodes to NSF
 - Existing metrics are effective
2. Nodes to Coordinating Office
 - To date nodes have been responsive to CO needs. No changes currently required.
3. Node to Node/Users
 - Node-driven activities that create a network greater than the sum of the parts. **May need more emphasis to motivate this type of activities**



New Equipment & Research (Lead: Kevin Walsh)

- Established comprehensive list of new equipment (and funding models/sources) within NNCI facilities:
 - 300 pieces of equipment valued at \approx \$67M (incl. two Cryo TEM valued at $>$ \$5M at RTNN and NNI)
 - 11 tools at $>$ \$1M; 16 tools at \$500k-\$1M; 86 tools at \$100k-\$500k
 - Financing Models: **direct purchase**; donation; loan; lease; trade-in
 - Funding Sources: NNCI funds (\approx \$1M); other federal grants; **university funds**; foundation; program income

Going Forward: Promote unique capabilities
on webpage;
Develop future
equipment
needs list



Working Groups

Network Support WG – Technical WG – Research Area WG

- **Equipment, Maintenance and Training**

Meredith Metzler (MANTH) - Lead

- **Vendor Relations**

Mike Khbeis (NNI) - Lead

- **EBeam Lithography**

Devin Brown (SENIC) - Lead

- **Etch Processing**

Vince Genova (CNF) - Lead

- **REU**

Lynn Rathbun (CNF) - Lead

- **K-12 and Community**

Jim Marti (MINIC) – Lead

- **Assessment & Evaluation**

Nancy Healy (SENIC) - Lead

- Planned: EHS, Geo & Env. Sciences, Life Sciences, Add. Manufacturing, ...

“One of the greatest strengths of the NNCI network is without doubt the combined staff expertise of the individual sites. To leverage this expertise at the network level, we propose the formation of various *working groups* composed of staff members from the NNCI sites.”

Working Groups

Working Group Topic	Working Group Lead
<i>Network Support</i>	
Equipment Maintenance & Training	Meredith Metzler (Univ. Pennsylvania)
Vendor Relations	Mike Khbeis (Univ. Washington)
Environmental Health & Safety	Nasir Basit (Northwestern) and Greg Cibuzar (Minn.)
<i>Technical Topics</i>	
XPS/UPS	Carrie Donley (UNC), Walter Henderson (Georgia Tech)
E-Beam Lithography	Devin Brown (Georgia Tech)
Etch Processing	Vince Genova (Cornell)
Atomic Layer Deposition	Michelle Rincon (Stanford), Xiaoqing Xu (Stanford), and Mac Hathaway (Harvard)
Photolithography	Pat Watson (Univ. Pennsylvania)
Additive Manufacturing	TBD
<i>Education and Outreach</i>	
K-12 and Community	Jim Marti (Univ. Minnesota)
Research Experience for Undergraduates	Lynn Rathbun (Cornell)
Workforce Dev. and Community Colleges	Ray Tsui (Arizona State)
Assessment and Evaluation	Nancy Healy (Georgia Tech)
Online Technical Learning	Angela An-Chi Hwang (Stanford)
<i>Societal and Ethical Implications</i>	
SEI Coordinators	Jamey Wetmore (ASU)

Example Working Group Outcomes: Workshops

NNCI MOCVD/ALD Symposium, April 7

[SNF Home](#) » [About SNF](#) » [This Page](#)

About the Symposium

The 2017 NNCI ALD/MOCVD Symposium will be held at Stanford University, on Friday, April 7, 2017, in the Paul G. Allen Annex Auditorium (101X) on the Stanford campus and will feature invited research talks as well as technical presentations by leading ALD and MOCVD service and equipment providers. This public symposium is free of charge; meals & snacks provided ([preregistration](#) required.)

Core Facility staff and managers are invited to attend the NNCI/NNIN-only meeting on Thursday, April 6, to share operational insights. Any questions, please contact the organizers: [Michelle Rincon](#), [Xiaoqing Xu](#), and [Mac Hathaway](#).

Agenda

9:00 AM Breakfast

9:20 AM Oxford Instruments., *Topic TBD*

9:40 AM Strem Chemicals Inc., *Topic TBD*

10:00 ALD Invited Talk – Prof. Andrew Kummel - UCSD
Topic "NanoFog ALD Gate Oxide Deposition on Graphene and TMDs"

10:40 Break

10:55 AM MOCVD Invited Talk – Prof. Debbie Senesky - Stanford University
Topic "MOCVD-grown AlGaIn/GaN-on-Silicon Microstructures for Harsh Environment Electronic Devices"

11:35 AM STR Group
Topic "Strain engineering tools for GaN-based device structures grown by MOCVD"

REU Convocation 2017 @ Georgia Tech



56 REU students from 10 NNCI sites
6 iREU students
4 Visiting graduate students from Japan

Science Outside the Lab

- Organized by ASU
- 1 week policy workshop in Washington, DC for graduate student scientists and engineers to meet with policymakers, funders, regulators, lobbyists, and judges
- May 2017 (annual event)
- 14 participants from 6 NNCI sites



NNCI Exit Questionnaire

- Survey link: <https://www.surveymonkey.com/r/J96CBDP>
- 10 questions on user background, how user found resources, what resources were used and user satisfaction with NNCI resources
- Send to NNCI site directors on October 10
- By October 13th: 197 responses from 9 sites!!!!
- Thank you all for sending out to your users!!!!

NNCI Video

- **Goal: Make promotional video about NNCI**
- Hired external contractor: **Kirsten (Kiki) Sanford**
https://en.wikipedia.org/wiki/Kiki_Sanford
- Kiki is attending NNCI Conference to record Q&A with select NNCI site directors and staff
- Kiki will collect video clips generated by NNCI sites
- Kiki will assemble content into 3-4 minute video clip
- Let's put NNCI into the best light!



Listen to our Neighbors: CMC Microsystems

- Dr. Andrew Fung
Client Technology Advisor
Microsystems & Nanotechnology
andrew@cmc.ca
- Microsystems & Nanotechnology Resources in Canada
 - Software Resources
 - Hardware Resources
 - Services Resources
 - Commercialization Resources



Use NNCI Conference to Discuss Challenges & Opportunities!

At the NNCI Site Level

- How can I maintain a state-of-the-art (evergreen) infrastructure?
- How can I attract (and retain) the required staff expertise?
- How can we best serve our customers?

At the NNCI Network Level

- How can we be more than the sum of our parts?
- How can we help (external) users? Especially from non-traditional areas?
- How can we help each other?
- How can we help/collaborate with other nanotechnology facilities/centers?
- How can we help nanotechnology start-ups?
- How can we educate the general public?
- How can we become the world-leading nanotechnology infrastructure network?

NSF 18-013: RFI for Midscale Instrumentation

NSF 18-013

Dear Colleague Letter: Request for Information on Mid-scale Research Infrastructure

October 6, 2017

Overview

This Request for Information (RFI) is issued in response to the American Innovation and Competitiveness Act (AICA, Public Law No. 114-329), Section 109. NSF seeks information on existing and future needs for mid-scale research infrastructure projects from the US-based NSF science and engineering community.

- https://www.nsf.gov/pubs/2018/nsf18013/nsf18013.jsp?WT.mc_id=USNSF_179
- RFI solicits ideas for midscale instrumentation: \$20-100M towards construction and/or acquisition
- Opportunities for NSE community? Scale-up/pilot facilities?
- Deadline: December 8, 2017

Next NNCI Conferences

- 2018: University of Washington
 - Date: September 5-6, 2018
- 2019: Cornell University
- 2020: Georgia Tech

Thank You!



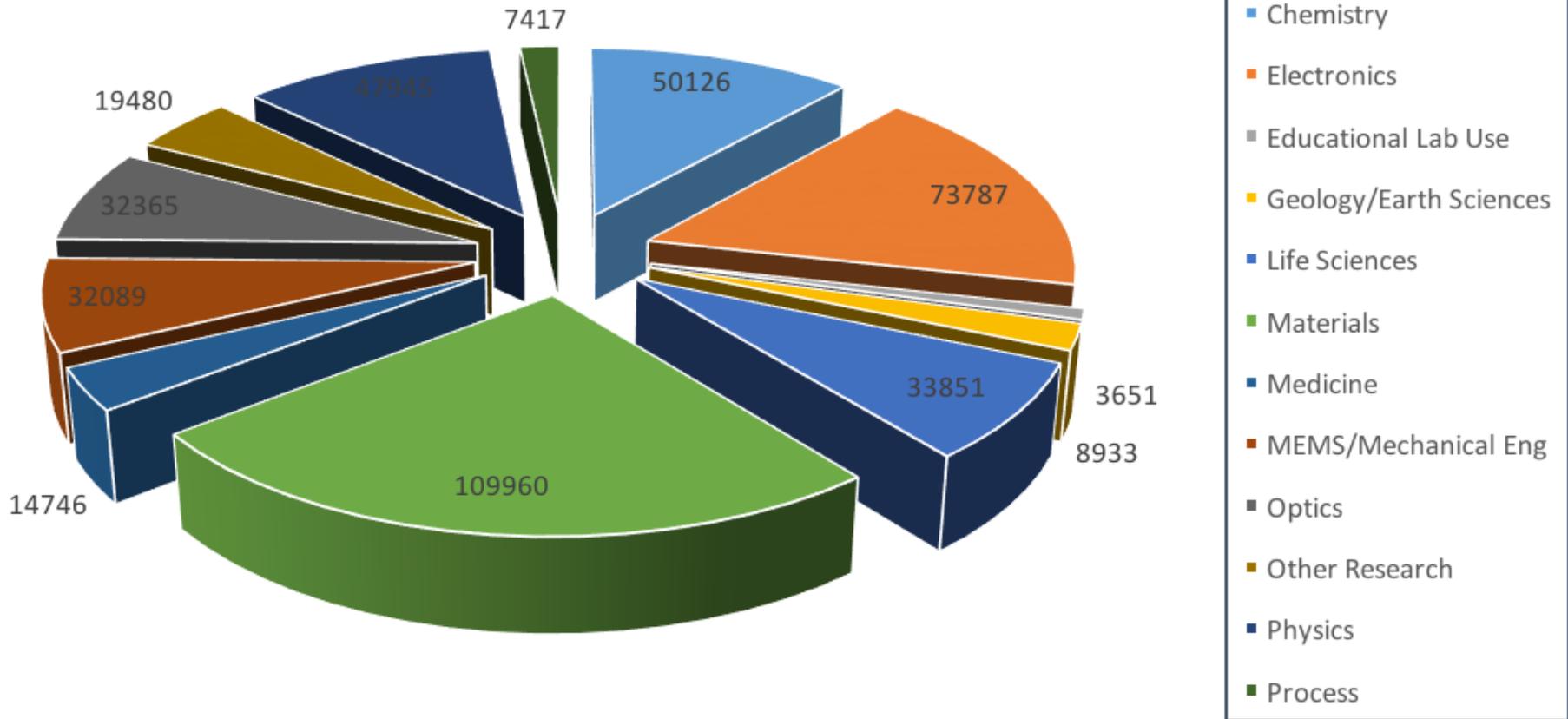
<http://www.nnci.net>

NNCI Year 1 User Statistics (10/2015-09/2016)

	NNCI Network	NNCI Sites Mean (Min - Max)
Unique Facility Users	10,675	667 (80 - 1,446)
Unique External Users	2,561 24.4%	160 (13 - 461) 24.4% (14.9% - 42.1%)
Industry Users	1,410	88 (6 - 202)
External Academic Users	1,151	72 (7 - 352)
Average Monthly Users	4,427	277 (40 - 679)
Users Trained	4,116	257 (36 - 699)
Facility Hours	>900,000	57k (3.6k - 175k)
External Facilities Hours	>170,000 20.2%	10,800 (322 - 50,500) 20.2% (1.4% - 43.4%)
Hours/User	85	85 (27 - 293)

*Note: approx. 32,000 annual PhD
in science/engineering*

NNCI User Data – Hours by Discipline



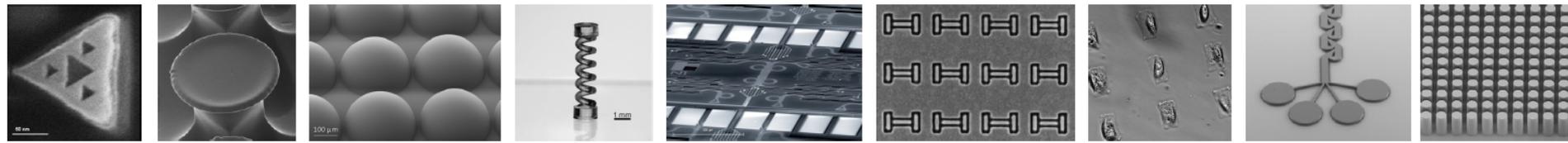
NNCI Website – Phase I (December 2016)

- **Overall design implementation**
- **Basic NNCI information**
- **Individual site pages**
- **Tool database (>2000 tools)**
- **Experts database (>200 experts)**
- **Contact forms** – general information and new user gateway
- **Education and outreach**
- **SEI**
- **Additional resources:**
Other nano infrastructure, link to computation at nanoHub)
- **NNCI news blog**

Workforce Development Sub-Committee (Lead: Trevor Thornton)

- Workforce Development Subcommittee has evolved into Workforce Development and Community Colleges Working Group. WG is chaired by Ray Tsui from ASU/NCI-SW. Interested members of the former Subcommittee continue to participate in the WG's activities.
- WG held kick-off teleconference on 4/27/17, with 5 participants on the call. Four other people provided inputs via email and an one-on-one call. In the meeting, relevant activities at the participating sites were described, including surveys conducted to gauge local industry needs.
- As a result, a summary of relevant activities and plans collected from 8 sites (NCI-SW, NanoEarth, MANTH, NNF, RTNN, NNI, SENIC, and CNS). A Dropbox was also created to share documents.
- Meeting minutes distributed to E&O Coordinators at all sites, with request that the other 8 sites also each provide a similar summary. This will help to produce a network-wide record of the relevant activities and goals in the focus areas.
- A follow-up teleconference will be scheduled to include participation from these other sites as well. Longer-term, the objective is to have a more coordinated effort across the network.

Example Working Group Outcomes: Workshops



Symposium on Direct Write, Optical, Ion and Electron Beam Lithography



July 14th, 2017

Stanford University
Paul G. Allen 101 Auditorium



This symposium features technical experts from Heidelberg Instruments, Nanoscribe, Zeiss and Raith who will describe the spectrum of latest, state-of-the-art direct-write capabilities. SNF and SNSF are part of NSF's NNCI@Stanford and make modern nanofabrication capabilities available to Stanford's community; we also welcome researchers from industry and other universities.

- | | | |
|------|-------|--|
| 9:00 | 9:15 | Welcome and Introductions
<i>Stanford University, Prof. Roger Howe</i> |
| 9:15 | 9:45 | Write Strategies for Optical Direct write Lithography
<i>Heidelberg Instruments, Niels Wijnaendts van Resandt</i> |
| 9:45 | 10:15 | Gallium Focused Ion Beam Applications |

124 Participants
3 NNCI Sites

Challenge: Travel Budget
Solution: Webinars?



Annual Reporting

Annual Coordination Office Report

- Due 3 months before award anniversary, i.e. January
Plan to submit by February 1st, 2018
- Include 12 months of user data from all sites
(October 2016 – September 2017)
- Include 3-page highlights from each site, committee reports

Annual Site Reports

- Responsibility of individual NNCI Sites
- Due 3 months before award anniversary, i.e. July 1
- Include only 8 months of user data from reporting year
- Format as was established with Year 1&2 reports