

# ***NNCI: Southeastern Nanotechnology Infrastructure Corridor (SENIC)***



JSNN  
Joint School of  
Nanoscience and Nanoengineering

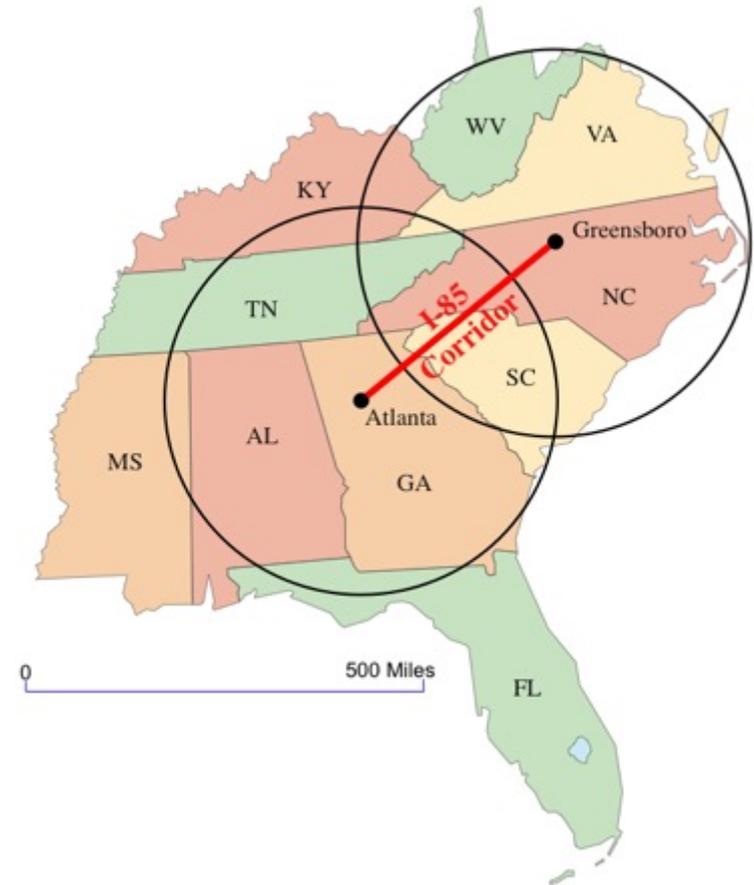


Georgia  
Tech  Institute for  
Electronics and  
Nanotechnology

# What is SENIC? <http://senic.gatech.edu>

Partnership of two major & modern nanotechnology centers in the southeastern US:

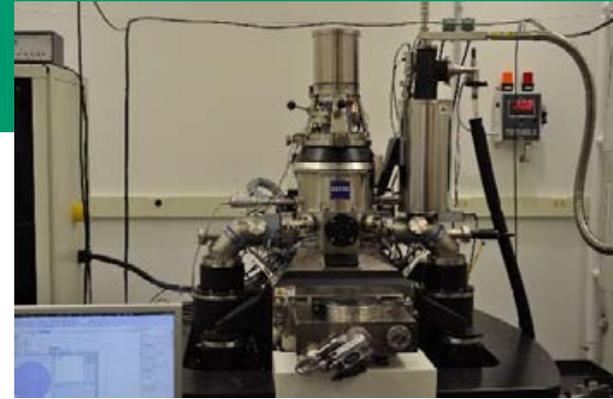
- **Institute for Electronics and Nanotechnology (IEN)**, an Interdisciplinary Research Institute & NNIN site at the Georgia Institute of Technology (GT)
- **Joint School of Nanoscience and Nanoengineering (JSNN)**, an academic collaboration between North Carolina A&T State University (NCA&T) and University of North Carolina, Greensboro (UNCG)



# SENIC Resources – 300+ Tools

- Top-down (up to 200 mm wafers & 300 mm panels) and bottom-up micro/nano-fabrication
- Advanced microscopy and surface analysis
- Analytical chemistry
- Materials testing
- Nanobiology

**+ Staff Expertise**



# SENIC Annual Meeting (June 1<sup>st</sup>, 2018)



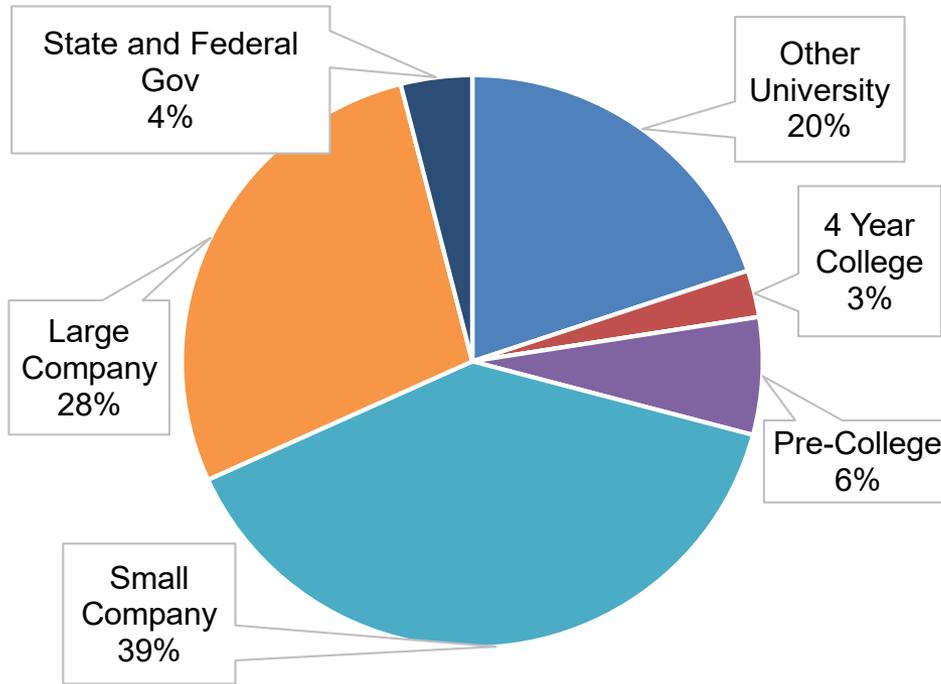
- Discuss and review SENIC program components
- Develop strategic plan with measurable metrics
- EAB provides feedback and make recommendations in form of oral and written report

# SENIC User Data

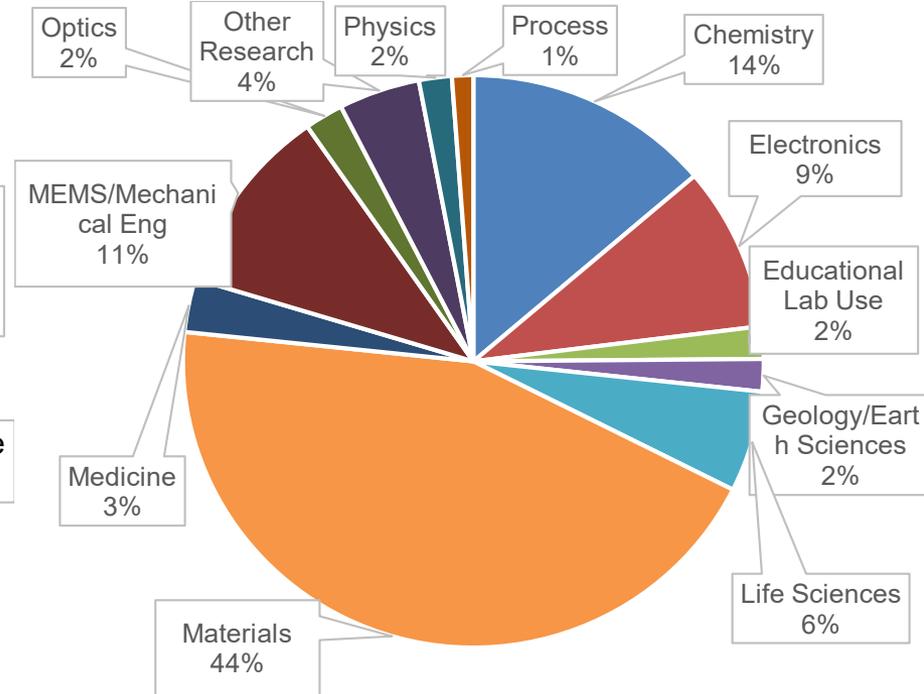
<b>Yearly User Data Comparison</b>			
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3 (6 months)</b>
<b>Total Users</b>	1067	1196	929
<b>Internal Users</b>	903	975	778
<b>External Users</b>	164 (15%)	221 (18%)	151 (16%)
<b>External Academic</b>	52	85	44
<b>External Industry</b>	109	130	101
<b>External Government</b>	2	3	6
<b>External Foreign</b>	1	3	0
<b>Total Hours</b>	79,581	85,275	47,756
<b>Internal Hours</b>	71,659	73,499	41,153
<b>External Hours</b>	7,922 (10%)	11,773 (14%)	6,603 (14%)
<b>Average Monthly Users</b>	447	498	523
<b>Average Ext. Monthly Users</b>	60 (13%)	63 (13%)	78 (15%)
<b>New Users Trained</b>	313	313	160
<b>New External Users Trained</b>	67 (21%)	110 (35%)	46 (29%)

# SENIC User Data

## External User Affiliations



## All User Disciplines



**Year 3 (6 months): 53 small companies; 19 large companies; 20 universities**

**Year 2 (12 months): 74 small companies; 20 large companies; 28 universities**

# Marketing Activities & User Outreach

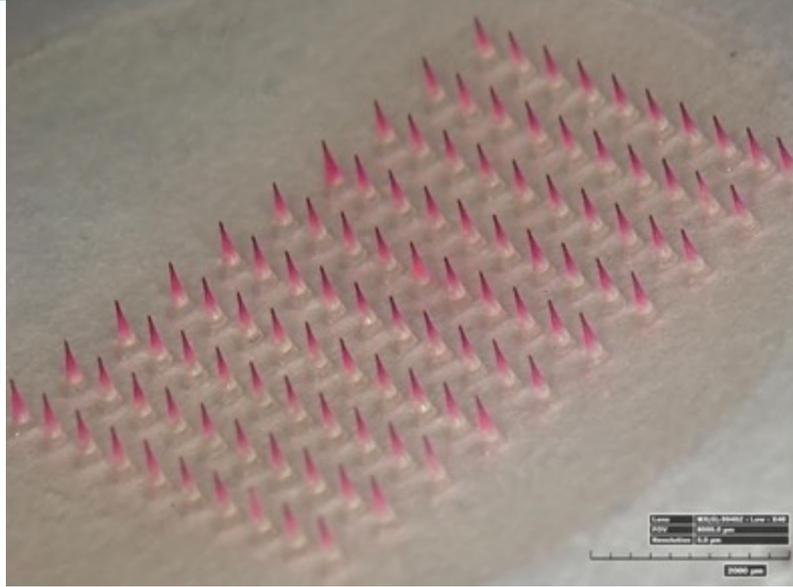
- **Websites** (SENIC, GT-IEN, JSNN)
- **Traditional and Social Media**
  - Email list from data mining of SBIR/STTR companies, alumni and SE faculty
  - Facebook, Twitter and LinkedIn
- **Collateral Materials** (bookmarks, brochures, banners, short videos)
- **Seminars**
  - Research Seminars (broadcast live via YouTube and archived)
  - Industry Seminars
- **Economic Development Outreach**
- **University & Company Visits**
  - Facilitated by current/past users
- **Hosting Conferences, Workshops & Short Courses**
- **Exhibiting at Regional Conferences & Trade Shows**
- **Seed Grant Program**



# New Tools & Tool Upgrades

- **≈\$4M investment** in approx. 25 tool acquisitions & upgrades
- **Lithography & Direct Patterning:** Elionix ELS-G100 EBL (6nm resolution; *new purchase*); Heidelberg MLA150 Maskless Aligner (1 $\mu$ m resolution; new purchase); Optec WS-Flex Laser Micromachining (ordered; new purchase)
- **Deposition:** Control Layer II Sputterer (AlN; *new built*); Trion Sputterer (GeSe; *upgrade*); CVC E-beam Evaporator (upgrade); Control Layer SEF Sulfurization Furnace (upgrade); Veeco/Ultratech S200 ALD (new purchase); Arradance GEMStar PE ALD (lithium materials; new purchase)
- **Etching:** PlasmaTherm ICP (dielectric etching; *used tool purchase*);
- **Imaging & Metrology:** Thermo Scientific Escalab Xi+ (XPS, UPS, ISS, REELS; new purchase); Varian 820-MS ICP-MS (new purchase); Horiba Raman Confocal Microscope (new laser; tool upgrade); Kruss Tensiometer (new purchase); Rheosense m-VROC Viscometer (new purchase); CytoViva Hyperspectral Microscope (new purchase); Thermo Scientific Microtome (new purchase)

# Research Highlights (out of 600+ publications)



## Flu Vaccine Delivery via Transdermal Patch

- Prausnitz Lab, Georgia Tech  
**Startup: Micron Biomedical**
- Clinical trial shows immune response similar to syringe vaccination
- Roupheal, N.G., et al., *Lancet*, 2017

## Solid-State Nanopore Analysis of DNA Base Modifications

- Hall Lab, Biomedical Engineering  
**Virginia Tech, Wake Forest U**
- Targeted detection of diverse modified bases in DNA
- Wang, F., et al., *Nano Letters*, 2017

# Education & Outreach Activities

Workforce Development		STEM Pipeline
Undergraduates	Graduates/Postdocs	K-12 & General Public
<ul style="list-style-type: none"> <li>• Research experience for undergraduates (REU)</li> </ul>	<ul style="list-style-type: none"> <li>• Tool &amp; process training (250+ trained)</li> </ul>	<ul style="list-style-type: none"> <li>• Demos in the Field: NanoBus &amp; Portable SEM</li> </ul>
<ul style="list-style-type: none"> <li>• Community college internships</li> </ul>	<ul style="list-style-type: none"> <li>• Short courses (GT-IEN)</li> <li>• Degree programs (JSNN)</li> </ul>	<ul style="list-style-type: none"> <li>• Science festivals</li> <li>• Facility tours</li> </ul>
<ul style="list-style-type: none"> <li>• Hosted 2017 NNCI REU Convocation (56 students)</li> </ul>	<ul style="list-style-type: none"> <li>• Workshops &amp; conferences</li> <li>• Seminar series</li> </ul>	<ul style="list-style-type: none"> <li>• Resources for K-12 teachers (RET proposal)</li> </ul>
<ul style="list-style-type: none"> <li>• Student assistants in core facilities (18 students)</li> </ul>		<ul style="list-style-type: none"> <li>• High-school interns</li> </ul>
<ul style="list-style-type: none"> <li>• Partnered with Remotely Accessible Instruments for Nanotechnology (RAIN) program at PSU</li> </ul>		



# SENIC Undergraduate Programs

- At GT-IEN: NSF REU Site (2018-2020): SENIC Undergraduate Internship in Nanotechnology (SUIN) - Summer Internship for Students from Southeastern Institutions (10 students per year)
- At JSNN: NIH: *Maximizing Access to Research Careers Undergraduate* (MARC) - Student Training in Academic Research (2 students per year)
- At JSNN: *Forsyth Technical Community College* – Interns from Nanotechnology and Biotechnology programs (4 interns per year)



# Impact of Education & Outreach Activities

SENIC 2017-2018 Education and Outreach events

Georgia Tech Site	# participants	Percent With USASEF	Percent without USASEF	JSNN Site	# participants	Percent
<i>K-12 students</i>	716	7%	14%	Nanobus K-12 outreach	915	26%
Atlanta Public Schools gifted program	100	1%	2%	<i>NC Science Festival/Gateway to Science event</i>	535	15%
Conferences Teacher - STEM	3240	30%	65%	High school career fairs	455	13%
USASEF	5000	46%		Facility tours	432	12%
<i>REU + CONVO</i>	84	<1%	<2%	High school interns	10	<1%
REU recruitment	335	3%	7%	Nanomanufacturing conference	179	5%
<i>Camp support</i>	86	<1%	2%	ACS Regional conf + TEDX Greensboro + Scimatch pairing	300	8%
<i>Teacher workshops</i>	62	<1%	1%	NIH/MARC Undergraduates	2	<1%
<i>ATLSF</i>	70	<1%	1%	Community college interns	4	<1%
<i>Technical events</i>	198	2%	4%	STEM Tech Savvy for girls	24	<1%
Other public	121	1%	2%	Canterbury Summer Science Academy	28	<1%
Nano at Tech seminar series	800	7%	16%	JSNN seminars	680	19%
Total GT	10812			Total JSNN	3564	
Total SENIC	14376					



Summary of Five K-12 Intro to Nano Events

N = 121	Not at all	Slightly	Moderately	A lot
Increased my knowledge of nano	1%	3%	31%	64%
Increased my interest in science & engineering	2%	24%	45%	30%
Helped me understand how nano relates to real world	1%	5%	31%	63%
Increased my interest in studying science & engineering in college		9%	26%	65%

Green boxes = evaluated activities.



Attitudinal assessment of student participants in GA Tech's Intro to Nanotechnology program.

# SENIC SEI Program

- **Focus: nanotechnology commercialization while still attending to social and ethical implications**
- “I-Corps Plus SEI”
  - Tool development - presentation, interactive exercise based on I-Corps and Business Model Canvas
  - Dissemination
    - NNCI SEI Winter School, AZ, January 2018
    - Georgia State University Faculty Entrepreneurship & Innovation Workshop (with a national I-Corps trainer), May 2018
- Nano-Informatics
  - Text mining of nanotechnology publication and patent title and abstract records
  - Uses
    - Identifying emergent nanotechnology topics
    - Broadening SENIC outreach
- Plans → Training video: “8 things you need to know about social implications of nanotechnology research in the cleanroom”
  - 4 things about doing research in the cleanroom
  - 4 things about working on commercial/commercializable products



# NNCI Cooperative Network Activities

## Network-Wide

- Serve on subcommittees (5) and initiate (2) / serve on (6) working groups
- Participated in National Nanotechnology Day on 10-9
- Participated in NSF Nano Grantees Conference (Dec. 2017)
- Attended REU convocation and NNCI annual conference

## Multi-Site

- Joint RET proposal (NCI-SW, SENIC, MINIC, KY MMNIN, NNF)
- Worked with RTNN on NC proposals for new research initiatives and other initiatives
- Installed SUMS (Shared User Management System) at Montana State as a pilot initiative
- Participated in ASU Winter School in January 2018
- Booth at SERMACS with RTNN and NanoEarth

## On Behalf of the Network

- Serve as Coordinating Office
- Hosted 1<sup>st</sup> NNCI REU Convocation in August 2017
- Participated in TechConnect Conference



# Panel on Workforce Development

- Consider student assistants in core facilities
  - Undergraduate Assistants
  - Federal Work Study (FWS) Students – D of Education
  - Co-op Students
  - Senior Design Projects
  - Graduate Research Assistants
- Benefit is both ways
  - Students help with core facility operation (e.g. training, equipment maintenance)
  - Students become more competitive for companies & graduate advisors
  - Students may be future full-time employees of core facilities

# Thank You!

<http://www.nnci.net>

<http://senic.gatech.edu>

<http://www.iem.gatech.edu>

<http://jsnn.ncat.uncg.edu>



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