NNCI: Southeastern Nanotechnology Infrastructure Corridor (SENIC)

2022 NNCI Annual Conference

SENIC Southeastern Nanotechnology Infrastructure Corridor

JSNN
Joint School of Nanoscience and Nanoengineering
North Carolina Agricultural and Technical State University
University of North Carolina at Greensboro

NSF

Georgia Tech
Institute for Electronics and Nanotechnology

SENIC: 3 Universities – 2 Locations – 1 Site

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

- **Institute for Electronics and Nanotechnology (IEN),** an Interdisciplinary Research Institute 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)

GT-IEN Marcus Nanotechnology Building

JSNN Building

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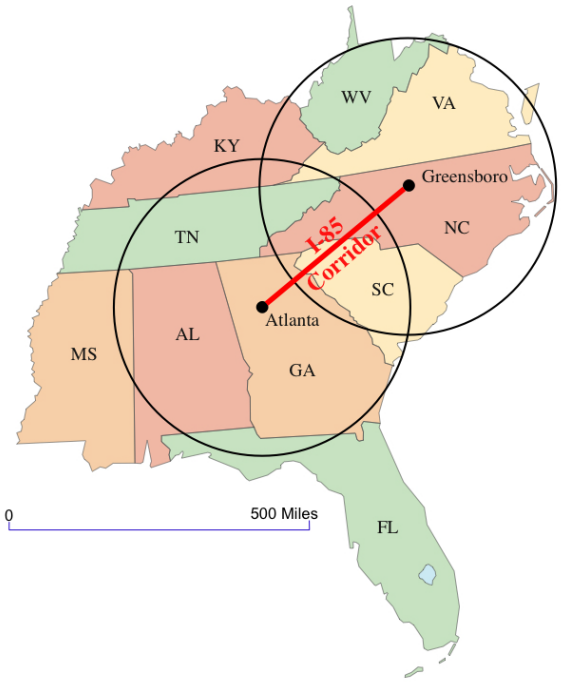
SENIC Vision & Strategic Goals (Years 6-10)

Vision Statement

*To be a **premier nano-fabrication and nano-characterization resource to southeastern US user communities** from academia, small and large companies, and government organizations, **providing tools, staff expertise, E&O activities, as well as SEI of nanotechnology programs**.*



Strategic Goals

1. **Develop and Serve Diverse User Base**
2. Develop Strong Synergies between Partners
3. **Expanding Capabilities based on Future Research Trends**
4. Develop E&O and SEI Programs Targeting the SE
5. Assist NNCI Network in Becoming More Than the Sum of its Parts

Updated strategic plan with **measurable goals**

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Directed Question(s)

- What **new program** have you introduced recently? What **issue/objective does this program** address? What are the benefits of this program?
- Do you see **potential to accelerate your site's growth**? If so, what opportunities do you see? If not, what challenges do you face?

SG3: SENIC Capabilities based on Research Needs

Measurable Goals

1. Add and/or upgrade at least 10 tools (or unique capabilities) per year
2. Develop strong partnership with Oak Ridge National Lab.
3. Facilitate regular discussions on tool capabilities to support future research needs.

SG3: Update SENIC Capabilities based on Research Needs

- **One-stop-shop** for fabrication and characterization needs
- **Key areas** where we see substantial growth:
  - Flexible & Wearable Electronics
  - Quantum Sciences
  - Next-Generation Electronics
  - Life Sciences, Medicine & Health
- Support **NSF 10 Big Ideas and other grand challenges** associated with e.g. security, energy, environment, health
- **NNCI Research Communities**
  - Nano-Enabled Internet-of-Things
  - Quantum Leap
  - Understanding the Rules of Life
  - Semiconductor/Microelectronics

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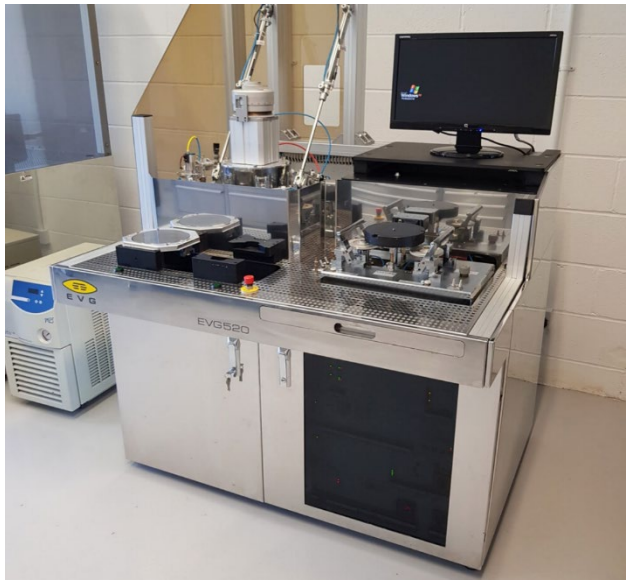
SG3: New SENIC Tools and Upgraded Capabilities

- **Nano/microfabrication**
  - **Advanced Lithography/3D printing**
    - Raith Voyager E-beam litho
    - OAI 808, Suss MA-8
    - Heidelberg MLA 300
    - Nanoscribe Photonic Pro GT2 Upgrade
    - 3D printers - BMF Micro and 3DGence
  - **Materials Deposition/Etch**
    - Veeco Fiji G2 ALD System
    - Plasma-Therm SiC, HDP CVD
    - AJA Sputterer (phase change materials)
    - Oxford FlexALD
    - Lesker ALD
    - CVD First Nano ALD/CVD (powder coating) via **NSF MRI**
  - **Packaging/Backend tools**
    - EVG-520 Wafer to Wafer Bonder
    - Disco 300mm Auto Dicing Saw
  - **Additional 15+ tools - upgrades**



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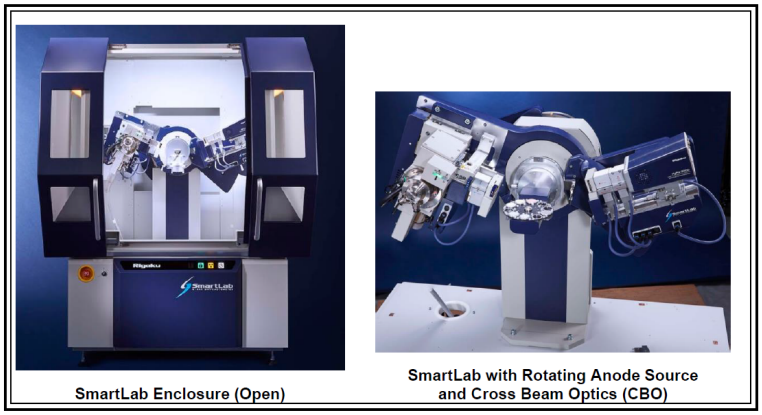
SG3: New SENIC Tools and Upgraded Capabilities

- **Characterization**
  - **Imaging/Sample Preparation**
    - ThermoFisher Helios 5 CX FIB/SEM
    - JEOL JSM-IT800 FESEM, EDX (**USDA**)
    - Leica UC7 Ultramicrotome
  - **Material/Analytical Characterization**
    - Rigaku XRDs – multiple (**NSF MRI**)
    - XPS, XRF, nanomechanical tester
    - WITecalpha300r Confocal Raman
    - Nikon XT H 225 ST µCT (**NSF MRI**)
    - Agilent 7900 ICP-MS, 1290 UPLC
    - Agilent 8890/5977b GC-MS
    - Agilent 7000 UV-Vis-NIR
    - Thermo is50 FTIR with RaptIR
    - Micromeritics 2060 BET
    - TA Instruments 5500 TGA
  - **Soft Matter/Biology**
    - Evident FV3000 Laser Confocal
    - Beckman Cytoflex Flow Cytometer


SmartLab Enclosure (Open)

SmartLab with Rotating Anode Source and Cross Beam Optics (CBO)

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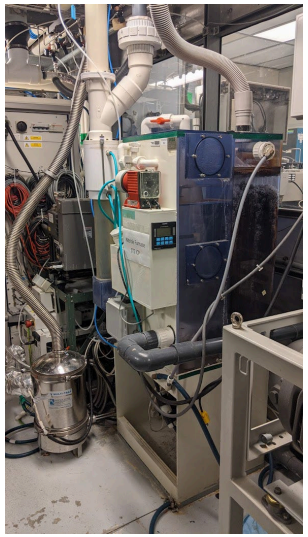
SG3: IEN Abatement System Improvement Project

- **Current Abatement Systems (20+ years old)**
  - Chemical Equipment Technology CET-J2 Scrubber
  - Delatech SD 202 R Scrubber
  - Delatech 875 CDO Burn Box
  - Low OEM support; High utility demand (costly to operate)
  - Total utility cost - ~$15K/month; 54% of which is water cost



- **Replace with Dry Abatement Systems**
  - Jupiter Scientific Callisto
    - Single Chamber - replaces CET-J2 Scrubber
    - Dual Chamber - replaces CDO Burn Box
  - Total investment - ~$220K

- **Savings**
  - Payback period - 17 months
  - 10-year savings - ~$1.29M

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SG3: Partnership with Oak Ridge National Lab

- **Joint user/project support**
  - Umbrella SENIC user proposal with Center for Nanophase Material Science (CNMS) at ORNL
  - SENIC users can get easy access to ONRL resources not available at SENIC and vice versa
  - Reciprocal tool backup

OAK RIDGE National Laboratory | CENTER FOR NANOPHASE MATERIALS SCIENCES

- **Joint staff exchanges** and training efforts
  - ORNL staff visit to SENIC and vice versa
  - Southeastern Nano Facility Network (SENFN) meeting

- Joint user meeting
  - Seminars via video streaming

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Directed Question(s)

- What steps has your site taken to **expand access of your site facilities and expertise** to underrepresented students, faculty, and research disciplines?

SG1: Develop and Serve a Diverse User Base

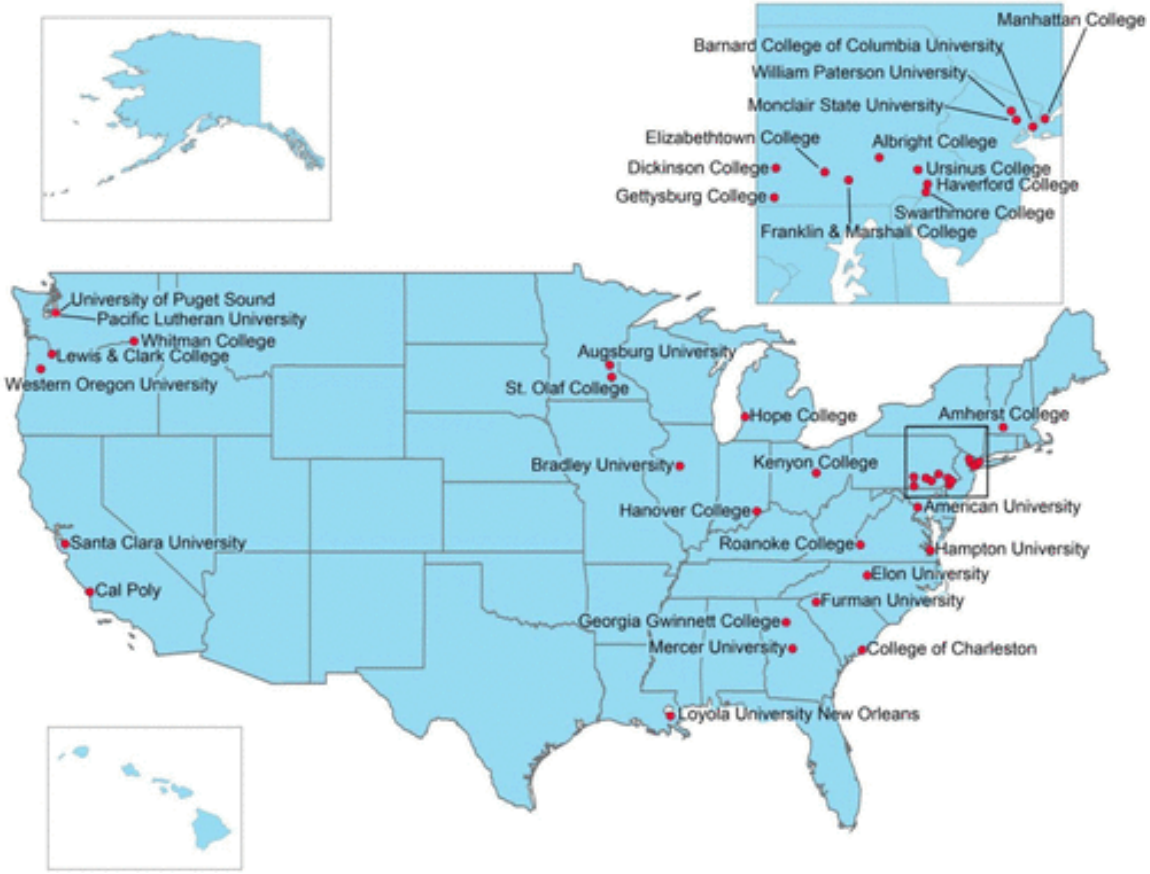
User base that is diverse in (i) technical and scientific background; (ii) demographics; (iii) institutional affiliations.

Measurable Goals

- Increase the number of non-R1 institutions (12 in Year 1) by 50% by the end of Year 5
- Double number of MSI (4 in Year 1) by the end of Year 5
- Increase the number of external users (250 in Year 1) by 10% annually, with an even distribution between external academic and industry users.
- Achieve 40% (35% in Year 1) of non-traditional users/disciplines by the end of Year 5.

SG1: Primarily Undergraduate Nanomaterials Cooperative (PUNC)

- PUNC is an organization for research-active faculty studying nanomaterials at Primarily Undergraduate Institutions (PUIs)
  - 37 PUIs
  - Community building, info sharing, and new collaborations.



Hughes, S.M., et al., 2021. ACS Nanoscience Au, 1(1), pp.6-14.

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Thank You!

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http://www.ien.gatech.edu
http://jsnn.ncat.uncg.edu

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