

Nanoengineering

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North Carolina Agricultural and Technical State University



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Enrollment

- The Nanoengineering degree programs were established in 2011.
 - » M.S. in February 2011
 - » Ph.D. in October 2011

- Nanoengineering enrollment has experienced steady growth.
 - » Steady-state enrollment target is 50 – 60 students
 - » Expected in Fall 2014

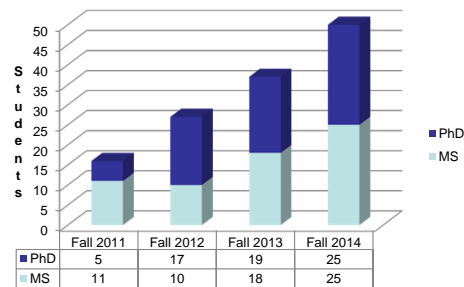
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Enrollment

Nanoengineering



- The Nanoengineering department receives >100 applications for 15 – 20 program slots each year.
- The Fall 2014 numbers are targets

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Retention and Graduation

- Retention has been good for the Nanoengineering degree programs.
 - » No losses to date from the M.S. program
 - » 9 of 31 have left the Ph.D. (to date)
 - Primarily due to failing the qualifying exam
 - Comparable to typical technical Ph.D. program retention rates
- Nanoengineering degree production.
 - » 5 M.S. degrees completed (2 more expected in May, 3 in August)
 - » First two Ph.D. degrees expected in December 2014

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Faculty and Staff

- Nanoengineering faculty.
 - » Currently 6.5 FTE with search underway (one faculty member is jointly appointed with CoE)
 - » Goal is to increase to ~10 within the next few years
 - Highly interdisciplinary research focus
 - High level of engagement with industry
 - » Staff includes
 - 7 Ph.D.-level EPA non-faculty researchers (3 state, 4 research contract)
 - 4 SPA technical and administrative staff

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Goals

- Complete JSNN facilities build-out
 - » New Nanoengineering facilities are planned for 2014 (self-assembly lab, cleanroom upgrade, high performance computing).
- Obtain national level designation for research and increase research funding
 - » e.g. member of team competing for lightweight materials NNMI opportunity
- Graduate first two Nanoengineering Ph.D. students
- Develop additional MOU's with U.S. and foreign universities to promote research collaboration and aid in student recruitment.
- Expand collaboration with other NC A&T SU academic units (e.g. working with Biology on their BUILD proposal)
- Continue to expand industrial and community outreach
 - » Nanomanufacturing Innovation Consortium now has 22 members
 - » Nanomanufacturing 2014 Conference scheduled for September
 - » Received \$75K philanthropic gift from Duke Energy Foundation for Mobile Nano Lab for STEM outreach

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Challenges

- Need to continue to grow the faculty in order to expand the department
- Successfully integrate outreach & economic development activities into the education and research enterprise.
- Continue to build research capabilities in an era of budgetary pressure
- Focus on collaboration with other NC A&T SU academic units despite our off-campus location
- Develop innovative methods of funding education and research other than state and federal sources.
 - » Continue to expand the Nanomanufacturing Innovation Consortium
 - » Build up the Materials Test Center with Gateway
 - » Expand industrial sponsored research

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Competition


- NC A&T SU's Nanoengineering Ph.D. degree program is one of four programs in the U.S.
 - » Competitors include CNSE, UT Austin, and UCSD
 - » Many other types of nano degrees are offered (Nanoscience, Nanotechnology, Nanoscale Science and Engineering, Nanomedicine, etc.)
 - » Most research universities have at least a nano lab or research center
 - » >250 universities world-wide offer a nano degree of some type
- In the UNC system, there are three other universities that offer nano degrees, but NC A&T SU's Nanoengineering program is larger and growing faster than its local competitors
 - » UNCC offers a Ph.D. in Nanoscale Science
 - » UNCG offers an M.S. and Ph.D. in Nanoscience
 - » NCSU offers an M.S. in Nanoengineering (on-line only)

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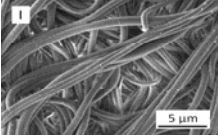

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Nanoengineering Research Thrusts (Nanomaterials)

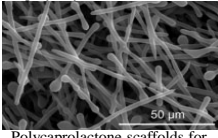
Transparent circuits for wearable computers & heads up displays
(Dr. Iyer: Spons or ARO)

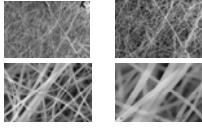
Multifunctional Polymer Composites Using CNTs
Dr. Kelkar: Sponsor AFRL/Clarkson Aerospace




Antimicrobial polyacrylonitrile filtration



Polycaprolactone scaffolds for tissue engineering (Dr. Zhang)






Vertically aligned CdSe nanorods for solar cells




A.M. Hung, T. Oh, J.N. Cha, *Nanoscale* **2012**, 4, 116

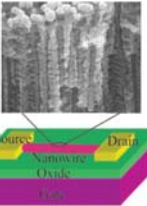
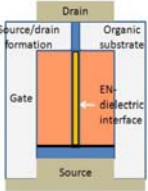


Dr. Kelkar: Sponsor NAVAIR/Triangle Polymer

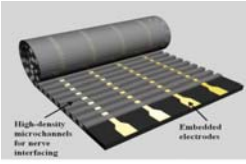
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Nanoengineering Research Thrusts (Nanoelectronics)

Nano-FET architectures – planar and vertical integration (Aravamudhan et al., 2007 and Lu et al., 2006) and SEM of high-density vertical metallic nanowires



3D micro-channel array embedded with electrodes for stimulation of nerve fibers
Dr. Aravamudhan

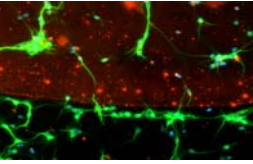
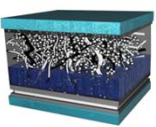



Image of stained neuronal cells on electrodes
Dr. Aravamudhan



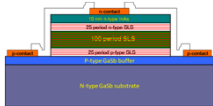
TiO₂ nanofibers & TiO₂ nanoparticles for photo anode of dye-sensitized solar cell (Dr. Zhang)



Highest mobility on Te-InSb (one of the highest reported)
Dr. Iyer

Very Long IR - 10- 20 μm


InGaSbN-InAs based superlattice



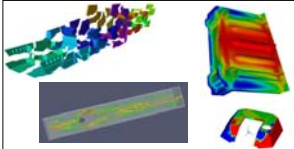
Military- Night Vision (MIR)

Deep space Target Recognition (VLWIR)
(Dr. Iyer: ARO)

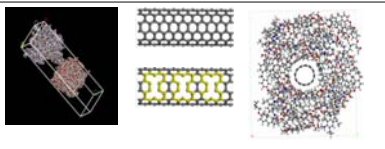
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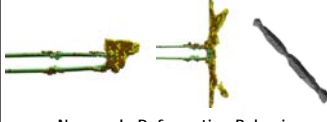
Nanoengineering Research Thrusts (Computational Nanotechnology)



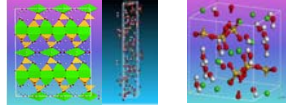
Composite Material Process Modeling



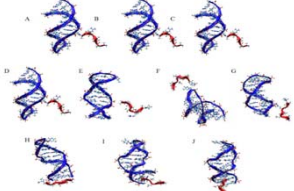
Polymer Nano/Hybrid Composites (Dr. Kelkar)



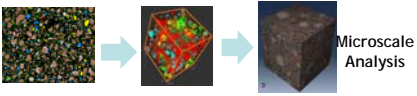
Nanoscale Deformation Behavior



Nanoscale Analysis
Tobermorite 14A Jennite




Peptide - Aptamer Molecular Interactions



Microscale Analysis
Nano to Continuum Modeling of Cementitious Materials


(Dr. Mohan)

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Members of the JSNN Nanomanufacturing Innovation Consortium (NIC)

- Cemala Foundation
- Engineered Biopharmaceuticals
- Evonik Industries
- FLIR Systems, Inc.
- Glen Raven, Inc.
- High Point University
- International Textile Group
- Joseph M. Bryan Foundation
- Quantapore, Inc.
- RF Micro Devices
- Schneider Mills
- Stearns Financial Group
- SunTrust Bank
- Syngenta
- Tannenbaum Sternberger Foundation
- The Quantum Group, Inc.
- Virginia Tech / Wake Forest University
- VF Jeanswear Limited Partnership
- Weaver Foundation
- Womble Carlyle LLP
- Xanofi



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