The NanoFab

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NanoFab Manager
NanoFab Overview

Providing researchers world-wide customized processing tools for nanoscale fabrication and measurement on a shared-use, cost-reimbursable basis through a straightforward application process designed to get users into the facility in a few weeks.

- NanoFab Staff: 12
  - Process Engineers: 7
  - Process Technicians: 1
  - Administrative Support: 2
  - Equipment Technicians: 2

- 19,000 ft² cleanroom; 8,000 ft² at class 100

- Advanced Nanofabrication and Metrology tools

- Additional shared-use tools outside the cleanroom
Outline

- Expertise
- Environment
- Tools
- Processes
- Accessibility
- Continuous Improvement
- Outreach
NanoFabrication Expertise

- Provide One-On-One Expert Training on Tools
- Ongoing Process Development Consulting to all users
  - Over 170 Years of Process Development Experience on Staff
- Process Development Services
  - Fee Based
- Vast Technical Resources to draw on as needed

NIST
- Vast measurement science knowledgebase
- Spanning many technologies and industries

CNST Research
- Nanotechnology Scientists
- Across many facets of Nanotechnology

NanoFab Operations Group
- Tool and Process Experts
- Experienced Process Engineers
The NanoFab Environment

- 19,000 ft Cleanroom; 8,000 ft² at class 100
  - Raised Floor Vertical Laminar Airflow

- Tight temperature control facilitates advanced processes and tools
  - 0.25°F Temperature Control
  - 2.0% Relative Humidity Control

- State-of-the-art Deionized Water Generation Plant

- Compatible with Substrate Sizes up to 150 mm dia.

- Automatic Hazardous Gas Monitoring
  - Direct connection to NIST firehouse

- Multi-Camera CCTV Monitoring

- Coral Software Used for Account Tracking
NanoFab Tools

- Thin Films
  - Sputter Deposition
    - 1 sputter tool dedicated to magnetic materials
  - E-beam Evaporation
  - Thermal Evaporation
  - LPCVD
  - PECVD
    - Including bio-compatible Parylene
  - Spin-On-Glass
  - Oxidation
NanoFab Tools

- Reactive Ion Etching
  - ICP, chlorine based metal etcher
  - Deep-RIE for high aspect ratio etching
    - An invaluable tool for MEMS research
  - 2ea Fluorine Based Multipurpose systems
    - Supports research of new RIE processes
  - XeF\(_2\) for rapid isotropic silicon etching
  - Microwave Oxygen Asher

more RIE to come
NanoFab Tools

- Lithography
  - Vistec VB300 E-Beam Lithography
  - MA6 Front/Backside Contact Aligner
  - MA8 Frontside Contact Aligner
  - Nano-imprint Lithography
  - Laser Pattern Generator
NanoFab Tools

- **Metrology**
  - Stress Measurement Tool: Toho Technology FLX-2320
  - Table-top SEM: Hitachi TM-1000
  - Scanning Electron Microscope: Zeiss Ultra-60 FESEM
  - Atomic Force Microscope: Veeco Dimension 3100
  - Atomic Force Microscope: Digital Instruments/Veeco
  - Dimension 3000 Contact Angle Goniometer
  - Spectroscopic Ellipsometer: Woollam XLS-100
  - Nanospec Reflectometer
  - Nanometrics Contact Profilometer: Dektak 6M
Accessibility

- The Registration Process is Straight Forward
  - Forms are available on web page

- An interactive process promotes success
NanoFab Process Development

Building Blocks for Nanotechnology Development

- E-beam Lithography Process EBL001
- E-beam Lithography Process EBL002
- E-beam Lithography Process EBL003
- E-beam Lithography Process EBL004
- Photolith Process CPL001
- Photolith Process CPL002
- Photolith Process CPL003
- Photolith Process CPL004
- Metal Dep Recipe SPT001
- Metal Dep Recipe SPT002
- Metal Dep Recipe SPT003
- Metal Dep Recipe SPT004
Established Processes Facilitate Success

- E-beam Lithography Process EBL001
- E-beam Lithography Process EBL002
- E-beam Lithography Process EBL003
- E-beam Lithography Process EBL004
- Photolith Process CPL001
- Photolith Process CPL002
- Photolith Process CPL003
- Photolith Process CPL004
- Metal Dep Recipe SPT001
- Metal Dep Recipe SPT002
- Metal Dep Recipe SPT003
- Metal Dep Recipe SPT004

Dr. Yaqub Afridi NIST/SED
Micro-scale Gas Sensor

Prof. Sungho Jin UCSD
Magnetic Nanostructures

Dr. Wenyong Wang NIST/SED
Nanopore Device for Molecular Transport Measurement

Hyun Wook Ro NIST/
Nano-Imprint Technology

SEM image of the test pattern
50nm

NIST
Setting New Standards in Nanotechnology

- NIST/SEMATECH Project to create AFM Standards
- Patterned HSQ Resist on Silicon
Continuous Improvement

- **New Capabilities**
  - JEOL JBX 6300FS E-Beam writer 4/2009
    - Provides needed capacity of E-Beam Lithography
    - Back up for this vital capability
    - Both are ICP systems with 12 gas input channels
    - Cryo and heated substrate capability
  - Nanometrics 6100 Reflectometer 3Q2009

- **Improved Systems**
  - New Web based Project Registration 3Q2009
  - Coral Based Tool Interlocks 4/2009
Ready for Prime Time

- The Time is right to launch Operation Outreach
  - The Tool set in the NanoFab is nearing Completion
  - The clean room environment has stabilized
  - Staffing is complete
  - Baseline Processes are in place
  - We have studied our Role Models
  - Established working relationships
NanoFab Operation Outreach

Making Our Presence Known is Key to our Success

- Increased Presence at Conferences/Trade Shows
- 2 Open houses planned for Q3 and Q4
- Nanofabrication Workshop in Q3
- Working with Local Tech Councils and Users Groups
- Aggressive outreach within NIST
- New Database being developed to track and maintain growth
NanoFab Summary

Helping the US Make Measured Progress in Nanotechnology

- Environment
- Outreach
- Tools
- Accessibility
- Continuous Improvement
- Expertise
- Processes