

## Nanoscale Science and Technology Laboratory

The Nanoscale Science and Technology Laboratory (NSTL) clean room facility offers the scientific and research communities a wide array of semiconductor-based device fabrication equipment. This premier research facility, which opened in June 2003, is located at the Oak Ridge National Laboratory (ORNL), a world leader in materials science, electronic device research, and nanofabrication.

The ORNL NSTL facility was constructed to support a wide variety of thin-film and solid-state electronic research projects and provides hands-on training and consultation in semiconductor-based device fabrication. The facility's available processes include photolithography, thin-film deposition and etching, metrology and imaging, and wet chemical processing. The NSTL wafer-scale fabrication facility is currently involved in nanotechnology-fueled genome research, nanomaterials

functionalization, and nanoscale electron optics research.

### Features

- Wide range of processes and microfabrication/nanofabrication techniques.
- Photolithography and etching.
- Thin-film deposition.
- Semiconductor-based device fabrication.
- State-of-the-art SEM, AFM, and optical microscopy.
- Contains 1,200 sq. ft. of class 100 and 1000 clean room space.

### Capabilities

#### Lithography

GCA AutoStep 200 step-and-repeat i-line photolithography system—capable of 0.5 μm resolution. The system is capable of fully exposing round substrates from 10 millimeters to 200 millimeters in diameter.



Nanoscale  
Devices and  
Systems

**Purpose:** NSTL offers a wide array of semiconductor-based device fabrication equipment to the scientific and research communities.

**Sponsors:** Various Work for Others sponsors.

- Features:**
- Semiconductor processing.
  - 1200 ft<sup>2</sup> of class 100 and 1000 clean room space.
  - Hitachi S4700 scanning electron microscope.

**Users:** Scientists and engineers from ORNL, universities, industries, and other government laboratories.

#### Complementary ORNL Facilities:

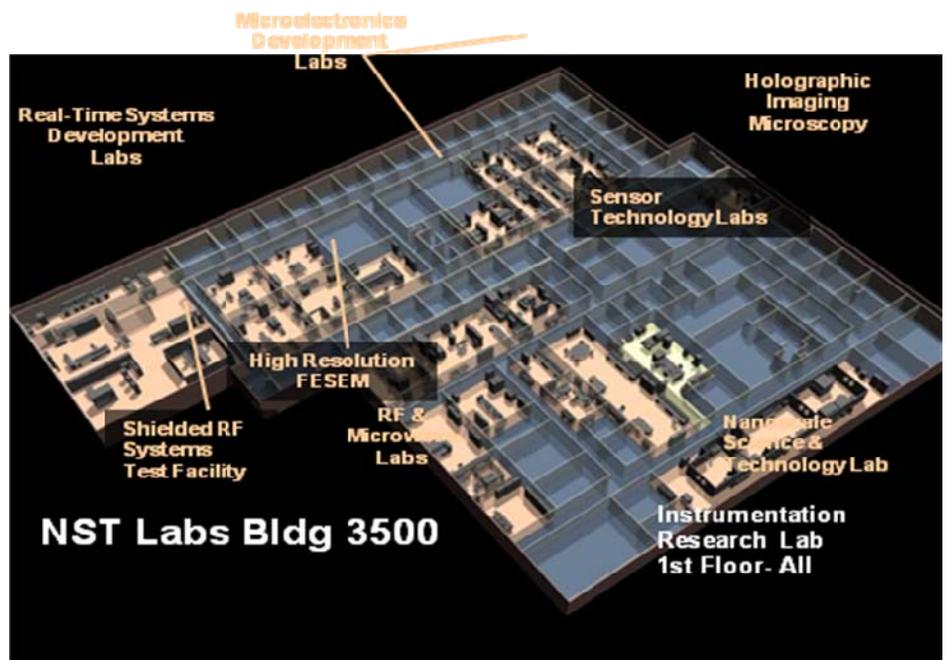
- Center for Nanophase Materials Sciences.
- High Temperature Materials Laboratory.

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Karl Suss MA-6 mask aligner—system with the ability to print submicron features on substrates from 50 millimeter to 150 millimeter in diameter. The system is equipped with both front and back alignment capability.

### Thin Film Deposition

Trion Technologies ORION PECVD System—plasma-enhanced CVD system capable of depositing SiO<sub>2</sub>, Si<sub>3</sub>N<sub>4</sub>, and amorphous Si. Substrate handling capability from small pieces up to 200-millimeter diameter wafer rounds.



Tytan Tystar LPCVD System—low-pressure CVD system capable of handling substrates in batches of 25 wafers per run. Maximum substrate size is 150 millimeters. Amorphous silicon, polysilicon, and n-phos. polysilicon capabilities.

Electron-beam evaporator—a 10 keV, 4-crucible electron beam evaporation system capable of depositing metal, dielectric, and semiconductor materials. Substrate handling capability from small pieces up to and including 3–100-millimeter wafer rounds.



DC Magnetron Sputtering System—single 2-inch magnetron sputtering gun system capable of depositing metals such as Cu, Ti, and W. Substrate handling capability from small pieces to 100-millimeter wafer rounds.

### Etching Processes

Trion Technologies ORACLE RIE System—cluster reactive ion etching system equipped with a dedicated ICP F<sub>2</sub>-based etch chamber and RIE Cl<sub>2</sub>-based etch chamber. Automated substrate handling capability from small pieces up to 200-millimeter diameter rounds.



Reynolds Tech acid/caustic etch bench—a laminar flow bench dedicated for wet chemical etching processes.

### Metrology & Inspection

Filmetrics F-40 thin film measurement system—reflectometer for measuring thickness and refractive index of optically transparent materials.

Tencor Alphastep profilometer—stylus profilometer system used for measuring step heights of a variety of materials.

Leitz optical microscope—brightfield/darkfield optical microscope with 1500× magnification capability. CCD camera for digital image capture.

Hitachi S-4700 scanning electron microscope—cold field emission SEM. Resolution of 2.5 μm at 1 kV at the microanalysis and specimen exchange position. Energy X-ray energy dispersive spectroscopy for rapid elemental analysis.



### Related Nearby Facilities

- The Center for Nanophase Materials Sciences is a collaborative nanoscience user research facility for the synthesis, characterization, theory/modeling/simulation, and design of nanoscale materials.
- The High Temperature Materials Laboratory is a Department of Energy User Facility dedicated to solving materials problems that limit the efficiency and reliability of systems for power generation and energy conversion, distribution, and use.

### Contact Information

For more information on accessing NSTL and related facilities, please contact Gary Alley (alleygt@ornl.gov) at 865-574-5725.