**[Center for Nanoscale Systems](http://www.cns.fas.harvard.edu/facilities/)**

**URL:** <http://www.cns.fas.harvard.edu/facilities/>

**Faculty Director:** Robert Westervelt

**Executive Director:** William L. Wilson

**Description:**

*Square Footage:* 20,000 square feet

*Facility Location:* LISE Building, 11 Oxford Street, Cambridge, MA 02138

The Harvard Center for Nanoscale Systems (CNS) provides staff and resources to acquire, maintain, and provide training for and assistance with advanced fabrication and test facilities for use by faculty, students, and external investigators. CNS operates as a shared-resource laboratory with equipment access typically charged on a dollar-per-hour basis. Technical support activities are provided in four categories

* Device Nanofabrication, assembly and test
* Electron-beam microscopy and analysis
* Materials characterization, imaging, and assembly including microfluidic and biomaterials.
* Optical and Scanning Probe Imaging and Spectroscopy

As one of the sites in the NSF funded National Nanotechnology Coordinated Infrastructure (NNCI), the facility is also open to outside academia and industry users.

**Major Equipment and Services:**

The Imaging and Analysis Facility includes tools for the following:

* Imaging Sample Prep for “hard” or “soft” materials
* Scanning Electron Microscopy (SEM)
  + FESEM Ultra55
  + FESEM Supra55VP
  + Zeiss EVO SEM
  + FESEM Ultra Plus
* Atom-Probe 3D Tomography
  + Cameca LEAP 4000X HR Atom Probe
* Transmission Electron Microscopy (TEM)
  + JEOL 2010 FEG – TEM/STEM
  + JEOL 2100 TEM
  + JEOL Atomic-Resolution Analytical TEM – ARM200F
  + Cs-TEM Aberration Corrected MC Zeiss 200-80
  + FEI Tecnai Cryo-Bio 200kV FEG TEM
  + FEI Tecnai Arctica CryoTEM with Autoloader

The Nanofabrication Facility provides resource and staff support for fabricating and characterizing nanoscale devices and structures. The facility currently operates the 10,000 square foot LISE cleanroom with leading-edge equipment capable of electron-beam and optical lithography, physical and chemical vapor deposition, dry and wet processing, metrology, and device characterization.

Available tools include:

* Back-End assembly and Characterization
  + Finetech Flip Chip Bonder
  + LSD-100 Scriber/Cleaver
  + Disco 320 Automatic Dicing Saw
  + EVG 501 Wafer Bonder
  + TPT Wire Bonder
  + WestBond Wire Bonder
* Electron Beam and Optical Lithography
  + Elionix ELS-F125 (125 keV, 5 nm resolution)
  + Elionix ELS-7000 (100 keV, 7 nm resolution)
  + Raith-150 30 keV E-beam Lithography System
  + Jeol JSM-7000M E-beam Lithography System
  + Heidelberg MLA-150 Maskless Aligner (405nm and 375nm wavelength, 1 um resolution)
  + Heidelberg DWL-66 Mask Writer (405 nm wavelength, 1 um resolution)
  + Heidelberg uPG Laser Direct Writing System (1.5 um resolution)
  + Nanoscribe 3D Laser Printer (150nm resolution)
  + RTS-GCA AS200 i-line Stepper
  + SUSS MA6 and MJB4 Mask Aligner
  + EVG 150 Auto wafer coater and Developer
* Metrology and Characterization
  + Characterization Electronics: Probe Stations, Semiconductor Analyzers,
  + Lakeshore 1.5K Probe Station
  + Hall Effect Measurement System
  + CDE ResMap-178
  + JAWoollam Spectroscopic Ellipsometer
  + Scanning Ellipsometer
  + CCI HD Optical Profiler
  + Bruker Dektak Profilometer
  + FLX-2320-S Thin Film Stress Measurement
  + Veeco NanoMan AFM
  + Hitachi SU8320 Scanning Electron Microscopy (SEM)
* Wet Processing
* Dry Etching
  + Oxford Cobra 300 ICP –RIE
  + SPTS Rapier DRIE
  + Plasma-Therm Diamond ICP-RIE
  + STS ICP-RIE
  + Unaxis Shuttleline ICP-RIE
  + Intlvac Ion Beam Etcher (IBE)
  + ULVAC Deep Oxide RIE
  + XeF2 Etcher
  + Matrix Plasma Asher
  + Anatech Barrel Plasma System
* Thin Film Deposition
  + Chemical Vapor Depositions, including PECVD, LPCVD, and Atomic Layer Deposition (ALD)
  + Physical Vapor Deposition, including Thermal Evaporator (TE), E-Beam Evaporator (EE), and Sputtering

The Nanomaterials Facility includes tools for the following:

* Advanced Optical Imaging
  + Muti-Photon/CARS laser system
  + Multiline Raman Spectrometer
  + Bruker Lumos FT-IR Microscope
  + Agilent Cary 60 UV-Vis Spectroscopy System
  + Olympus FV300 Laser Scanning Confocal
  + Reflection Laser Scanning Confocal Microscope
  + TIRF Laser Microscope
  + Nicolet iS50 FTIR Spectrometer
* Biological Sample Preparation/Cell Culturing Facility
* Microfluidic assembly and Soft-Lithography
* Nanoparticle handling
* Focused Ion Beam Systems (FIB)
  + Zeiss NVision 40s (CryoSEM and CryoFIB capable)
  + FEI Helios Nanolab 660 (FIB/SEM)
* Materials Preparation
* Metrology
* Scanning Probe Microscopy
  + Asylum - 1 MFP-3D AFM System
  + Asylum - 2 MFP-3D Coax AFM
  + Asylum - Cypher (AFM/STM)
  + Molecular Vista – PhotoInduced Force Microscopy
  + WITec Confocal Raman Microscope/SNOM/AFM
  + NeaSpec NanoIR Nearfield Spectroscopy System
* Soft Materials class 10,000 Cleanroom
* XRF
  + Spectro XEPOS XRF
* XPS
  + Thermo Scientific K-Alpha XPS
  + Nexsa XPX/UPS
* MicroCT
  + Nikon Metrology (X-Tek) HMXST225 MicroCT