

FACILITIES, EQUIPMENT AND OTHER RESOURCES

The Materials Science and Engineering (MSE) Department at the University of Florida (UF) have a wealth of organizational, administrative, and technical resources. The department maintains a number of support offices through a combination of institutional and departmental funds. These offices provide support to the faculty in academic advisement, fiscal activities, information technology, and contracts & grant management. These offices are in turn supported by offices at the College and Institutional level. In total, there are 16 secretarial staff, 8 research scientists, 4 academic advising staff, 3 contracts and grants staff, 7 financial office staff, 2 network services staff, and 2 payroll staff. Additionally, each of these offices is supported by a number of non-permanent student workers.

The department is located across three primary campus buildings: the Nuclear Sciences Building (NSC), Rhines Hall (RHN), and Materials Engineering (MAE). The PI offices and most of the support staff are located within Rhines Hall. However, all of these buildings neighbor one another and are in an easy walking distance. Seven lecture rooms are available for the faculty for use in seminars, group meetings, or other research and teaching activities.

The department maintains its own IT department and dedicated servers to meet the computing needs of both faculty and students. Rooms in Rhines Hall have been set aside to serve as a student lounge and computer laboratory. Nine workstations, a scanner and a high output printer are provided for student use with a 802.11 wireless network infrastructure in NSC, Rhines, and MAE halls to provide student laptops with the ability to connect to MSE network, and the Internet at large.

Professor Nino oversees 2 laboratories within Rhines Hall at the University of Florida and has unrestricted access to multiple other laboratories throughout the department. Equipment available within these laboratories is detailed below. The material synthesis and processing laboratories have solid state and chemical route capabilities for synthesizing materials in single crystal, nanopowder, nanofiber, thin film, and bulk form. The labs also have an array of low and high temperature furnaces including box, tube, atmosphere, vacuum, quenching, vertical, and horizontal configurations. Consolidation techniques include uniaxial and isostatic pressing, and tape casting. The electrical characterization laboratories are equipped with several apparatus for measuring resistance, electrochemical impedance, capacitance, current and voltage as a function of frequency (DC to 8.5 GHz), temperature (liquid nitrogen to 1200 K) and atmosphere. For the proposed extended crystallographic and compositional characterization of the synthesized materials the investigators have access to the different multi-user facilities at the University of Florida.

Equipment in Prof. Nino's Labs

Major equipment is located throughout the Nino Research Group (NRG) laboratories and other laboratories within the MSE department. The following equipment and facilities are available to the investigators for the entire duration of this project:

Electronic Ceramics Processing Laboratory

Crystal Growth and General Processing Equipment



1300°C EDG Vertical Tube Furnace (bore dimension 3x24 inches) - from Mellen Company, Inc., is configured with 24 individually controlled heater zones which allows for a precise and dynamic control of the temperature profile. The temperature gradient can be programmed to translate along the length of the furnace bore, which eliminates the need for a dropping motion of the sample during crystal growth. (208 Rhines)



1300°C EDG Vertical Tube Furnace (bore dimension 3x24 inches) - from Mellen Company, Inc., is configured with 12 individually controlled heater zones which allows for a precise and dynamic control of the temperature profile. The temperature gradient can be programmed to translate along the length of the furnace bore, which eliminates the need for a dropping motion of the sample during crystal growth. (208 Rhines)



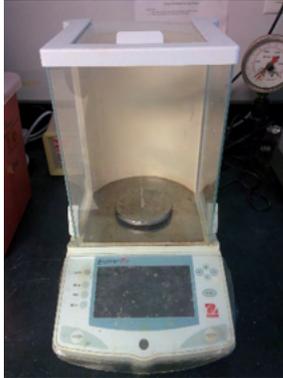
SType F2110 Tube Furnace - A Barnstead International furnace works within a temperature range of 100°C - 1100°C. Used for high temperature electrical measurements. (208 Rhines)



Planetary Ball Mill—This ball mill uses uniform balls in a rotating bowl to reduce the size of particles within the mill. The Fritsch Pulverisette 7 has 70 ml zirconia milling bowls that can rotate up to 1100 rpm and can produce a final particle size of <0.1 μm. (256 Rhines)



Ball Mill - Equipment made by US Stoneware. Uses uniform balls in a rotating jar to reduce the size of particles within the mill. (256 Rhines)



Digital Scales (Balances) (3)

- The Mettler AE 240 scale (left) has a 5 digit display in a closed draft shield with a 250 g limit (256 Rhines).
- The Ohaus Explorer Pro EP114C has a maximum capacity of 110 g with 0.1 mg readability and includes a draft shield (256 Rhines).
- The Denver Instruments, model PI-214 (right) has a maximum weight of 210 grams with a 0.1 mg minimum read. All balances have a manufacturer's density measuring kit. (208 Rhines)



Sartorius Digital Balance – The Sartorius Entris digital balance is a larger digital balance with a capacity of 2200g with a readability and precision of 0.01g. The larger pan offers the ability to measure larger amounts of materials and greater flexibility. (256 Rhines)



Hydraulic Press(2) - Manufactured by Carver (model: 3912) is used in conjunction with die to compress a loose ceramic powder into a pellet using uniaxial force. The clamping force of this particular model is 12 tons. (256 Rhines)



Drying Oven-Quincy Labs, Inc. oven (model: 10 GC) and Fisher Scientific, model 650G featuring temperature range of 50-225°C and 5.0 ft³ capacity. Used to dry a sample before pressing or analysis. (256 Rhines)



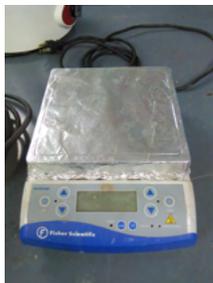
Vacuum Drying Oven- This vacuum drying oven model VO-16050 is from Across International. Maximum temperature 300°C, minimum vacuum 0.09 MPa. Used to dry a sample before pressing or analysis when a vacuum is required. (256 Rhines)



QL Model 10 Lab Oven Digital Solid Steel Door Incubators
Trouble-free design heats up to 93°C (199.4°F). Welded double-wall construction is sturdily reinforced to withstand rugged environments. Interior is aluminum with an ivory powder-coated exterior finish. (208 Rhines)



Thermo Scientific SP194715 Hot Plate-A hotplate is used for baking and curing thin films and coatings. (Speed: 100-2500 rpm Temperature resolution: 1°C Temperature Range: 150-538°C Voltage: 120V Amp: 3.45A Herz: 60Hz) (256 Rhines)



Fisher Scientific Isotemp Digital Stirring Hot Plate- A hotplate is used for baking and curing thin films and coatings. (Cat#: 11-800-49SH Speed: 60-1200 rpm Temperature Range: 30-550°C Voltage: 120V Amp: 7.5A Herz: 60Hz) (256 Rhines)



Fisher Scientific Thermix 120S Small Vessel Stirrer- This is used for mixing. (Speed: 200-2500 rpm Diameter: 6in Height: 3in) (256 Rhines)



Corning PC-353 Stirrer- This is used for mixing. (Speed: 80-1000 rpm measures: 5x7in) (256 Rhines)



IKA RO 10 Power IKAMAG Magnetic Stirrer- Multi-position magnetic stirrer with 10 stirring positions, without heating. The stainless steel surface covers the unit allowing easy cleaning and providing protection against the penetration of liquids. (256 Rhines)



NaBond Electro-spinning and Spray Unit-This system uses electrostatic and mechanical force to spin nanofibers with diameter of 20-1000nm from a solution/molten precursor. Single nozzle, multi nozzle, and coaxial nozzle spinnerets available. High voltage power supply reaching 50kV. Many options for rotating collectors are available including drum and disk collectors. (256 Rhines)



Carbon Coater-The carbon coater is used to coat otherwise non-conducting samples for SEM or x-ray scattering analysis. The EMS150R E from Quorum Technologies is a compact rotary-pumped carbon coater. (256 Rhines)



Sputter Coater-The sputter coater is used to coat otherwise non-conducting samples for SEM or x-ray scattering analysis. This particular sputter coater is capable of sputtering gold or platinum. (208 Rhines)



1100°C Box Furnaces (3) - from Lindberg/Blue M (interior dimensions 4x8x4, 6x9x6, and 12x18x12 inches) with multi-step programmable controller and gas/atmosphere flow intake and exhaust valves. (208 Rhines)



1700°C Rapid Heating furnaces (2)- (chamber dimensions 4x4x4 and 8x8x8 inches) – from CM Furnaces Inc with multi-step programmable controller and optical window. (208 Rhines)



1800°C Bottom Loading and Quenching Furnace - (chamber dimensions 6x6x6 inches) – from CM Furnaces Inc., includes a multi-step programmable controller and bottom lowering motor. (208 Rhines)



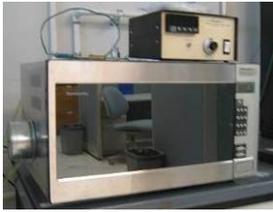
Thermo Scientific Benchtop Muffle Furnace (2)-Excellent for quantitative analysis, quenching, and organic and inorganic ashing applications. The furnace can run up to 1200°C and has high thermal-shock resistance. (208 Rhines)



1800°C Atmosphere/Vacuum Tube furnace - (chamber dimensions 3x12 inches) - from CM Furnaces Inc., is has an atmosphere controller and multi-step programmable temperature controller. The furnace can also run on vacuum. (208 Rhines)



1200°C Atmosphere Tube furnace - (chamber dimensions 2x10 inches) – from CM Furnaces Inc., Programmable Ramp and Soak controller. Used for BiI_3 powder synthesis through physical vapor transport. (208 Rhines)



Microwave Furnace – from ThermWave Mod. III is a 2.4 GHz Microwave Furnace System designed for high temperature processing of materials. The furnace has a temperature range of 400°C to 1700°C with 1300 watt power unit. (208 Rhines)



Tube furnace and Controller - Lindberg blue furnace (Model number: HTF55322A Chamber diameter: 1-3 inch) works within a temperature range of 100°C - 1200°C. (208 Rhines)



Lindberg Tube Furnace (2) – Model Number: F21135 Tube Furnace, multi-position, heats from 100°C to 1200°C. (Rhines 208)



Bench Top Wire Saw - from MTI Corporation, model SXJ-2. The bench top wire saw is used to section ceramic samples. This wire saw has a built-in digital micrometer head allowing for 2" travel distance and 0.003 mm accuracy, 360 degree rotating and 30 degree tilt stage, wire traveling speed is 0 – 5 mm/sec, and cutting thickness up to 50 mm. (270 Rhines)



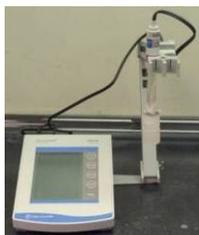
1100°C 3-zone Tube Furnace - from Lindberg/Blue M (bore size 6", tube length 60") with multi-step programmable controller and gas/atmosphere flow intake and exhaust. (125 NSC)



Incubator - Barnstead international (model: 150), operating temperature ambient to 40°C, with the chamber dimensions (12.7" W x 13.4" L x 12.7" H). (208 Rhines)



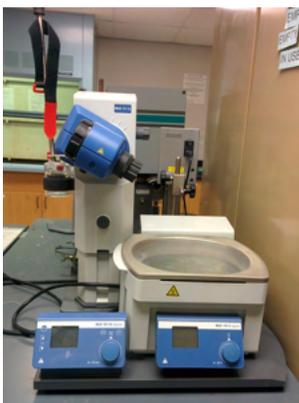
Model 900 Grinding and Polishing Machine -from Southbay technology. The grinding machine is used to polish a ceramic pellet by using progressively finer polishing pads to smooth the sample's surface. (256 Rhines)



pH/mV/°C Meter-Manufactured by Accumet, the AB15/15+ model can measure pH, absolute mV, relative mV and temperature. Resolution to 0.01pH. (256 Rhines)



Glove Box – The glove box is used for precise control of the atmosphere, or lack thereof, in which a sample is being worked on. This glove box model 5220100 from Labconco provides a leak-tight environment for work with contamination-sensitive materials. (256 Rhines)



IKA RV 10 Digital Distiller/Rotary Evaporator–The rotary evaporator removes a solvent from a sample using a rotating flask in a water/oil bath. A low pressure atmosphere to increase speed and efficiency of the evaporation process. The temperature of the water/oil bath can be controlled and the stage is motor-activated. (256 Rhines)



Caframo Overhead Mixer Stirrer: RZR1(left) and BDC250(right) – Stirrers for mixing reactions, samples, and solutions.

RZR1 spec: Volume 7.6L, Operating speed 315-2700 rpm, Power 115V 60Hz

BDC250 spec: Volume 2L, Operating speeds 50-2500 rpm, Power 100-240V

(256 Rhines)



I&J Fisnar Liquid Dispenser – Analog pneumatic liquid dispenser that can be used as a syringe pump. Suitable for all types of fluids. Barrel suck-back ensures no dripping. Air input 70 to 100 psi, air output 1-100 psi. (256 Rhines)



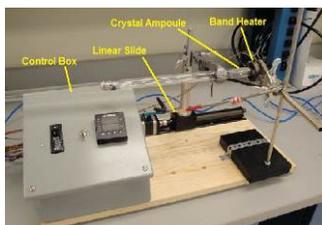
Chemat Scientific KW-4A Spin Coater– A spin coater deposits a film/coat by using a two-stage spin process which includes dispensing the film/coat at low speed and homogenizing the film/coat at high speed. The KW-4A spin coater can be used to deposit metal oxide thin films, polymer coatings and metal organic thin films. Stage 1 rotation speed 500-2500rpm, Stage 2 rotation speed 800-8,000 rpm. (256 Rhines)



Chemat Scientific KW-4AH Hot Plate-A hotplate is used for baking and curing thin films and coatings. The KW-4A hot plate allows a temperature resolution of 1°C and a Temperature Range of 50-350°C.(256 Rhines)



Chemat Scientific KW-4AC UV Curer- The KW-4AUV is specially designed for curing photosensitive coatings and thin films. It uses two UV light sources with radiations at 365 nm and 245 nm.(256 Rhines)



Travelling Zone Setup - This setup is used to purify BiI_3 single crystals. The setup consists of a Watlow Cable Coil heater, Athena series 16C temperature controller, which uses a PID loop for temperature control. The Stepper motor and its programmable controller are manufactured by Oriental Motor company. (208 Rhines)



Diamond saw – The diamond saw is used to section material samples. This PICO 150 Precision Saw utilizes wafer blades that can range from 3 to 7 inches in diameter. The blade is capable of sectioning a wide range of materials from soft, brittle composites to hard, tough ceramics. The device has a variable speed motor that ranges from 50 to 1500 rpm and a micro-precision dial for adjusting the cut section. This device comes with a selection of attachable sample saddles for holding a variety of material shapes and sizes. (256 Rhines)



Centrifuge – The centrifuge is used to separate particulates out of a liquid in order to isolate a solid or separate a liquid into layers of density. This Champion bench top centrifuge is a single-speed 3300 rpm model with the capacity to hold up to eight 15 mL sample containers. (256 Rhines)



Isostatic press – An isostatic press is used to exert a uniform and 3-D force on a sample by applying pressure to an oil chamber containing the sample. This 3-D pressure is useful to achieve a greater sample density as the entire surface area of the sample experiences the resulting compression. This particular isostatic press exerts a maximum of 34 MPa of pressure. Model CIP-50M. MTI Corp. (256 Rhines)



Pressure Reactor (Autoclave) - Designed for creating conditions for reactions that require high pressures and temperatures. Used for the growth of crystals from a variety of solvents at different concentrations. (208 Rhines)



Sonicator – Used to agitate and disperse particles within a solution. This is useful in creating a uniform solutions, emulsions, and suspensions in relatively short periods of time. Can also be used for ultrasonic cleaning of equipment as the ultrasound loosens particles adhering to a surface. (256 Rhines)



Branson 2510 Ultrasonic Cleaner – Tank Size: 6" x 5.5" x 4"(LxWxD) Tank Capacity: 1/2 gallon Frequency: 40 kHz (208 Rhines)



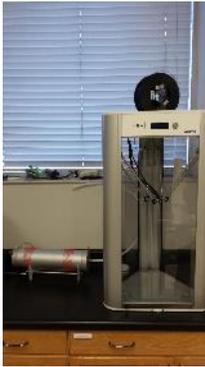
Vacuum Chamber – Used in PIP (polymer impregnation and pyrolysis). It is specifically used to supplant air in pores of a sample with polymer. The tube is connected to a roughing pump and the arm holds a 100 mL beaker which is used to pour the polymer onto the sample(s). (256 Rhines)



Across International WK-1 Pressing Die Set + Temperature Controller – The kit contains a 13 mm ID stainless steel dry pressing die set, a 50 mm heated cylindrical hardened steel dry pressing die set and a temperature controller. Used in ceramic processing to cut or shape the material. (256 Rhines)



Campbell Hausfeld WT500000AV Porta-Torch Kit – Used to heat and weld something. It has gas cylinder of oxygen (right) and acetylene (left). (208 Rhines)



3D Printer Wasp 20x40 - Designed for 3D prints of ceramic or polymeric samples.

Technologies: fused filament fabrication

Cylindrical Print Area: Ø 200 mm - h400 mm

Max Print weight: 442 mm Nozzle diameter: 0.4 mm

Print resolution: 005 mm < 0.25 mm

Accuracy vertical axis 0012 mm

Maximum speed: 300 mm / s

Filament diameter: 7.75 mm*

Filaments used: ABS, PLA, PET, Nylon, Flex, Polystyrene, Laywood, Experimental CHANGEABLE EXTRUDER

With extruder for fluid-dense materials you can use clay porcellane, etc

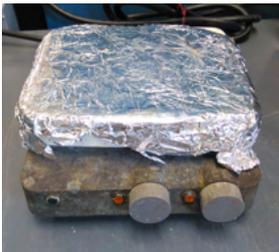
(Arts Department B6 FABC)



Thermo Scientific Cimared - Hot plate - A hotplate is used for baking and curing thin films and coatings. This hot plate allows a temperature resolution of 2°C and a Temperature Range of 5 - 400°C. (256 Rhines)



Thermo Scientific Cimarec - Hot plate - A hotplate is used for baking and curing thin films and coatings. This hot plate allows a temperature resolution of 2°C and a Temperature Range of 5 - 400°C (256 Rhines)



Hot plate - A hotplate is used for baking and curing thin films and coatings (208 Rhines)



Manual Sealer- Impulse Sealer model AIE-200. Used to seal plastic bags. (256 Rhines)



Voltage Source (2) Regulated High Voltage DC Power source. (256 Rhines)



16' Scroll Saw - is a narrow-bladed saw for cutting decorative spiral lines or patterns (256 Rhines)



pH/mV/°C Meter- Can measure pH, absolute mV, relative mV and temperature. (256 Rhines)



20MHz Sweep/Function Generator – from BK Precision, model: 4040A, allows for sine, square, pulse, and ramp output. (208 Rhines)



TDS 3012 Two Channel Color Digital Phosphor Oscilloscope - from Tektronix. (208 Rhines)

Electroceramic Characterization



Anter Flashline 4010 Thermal Properties Analyzer -Used to determine thermal diffusivity, thermal conductivity and specific heat capacity. Furnace operation from RT to 1600°C with carousel for four (up to 16 mm diameter) specimens in vacuum, air, or inert gas purge. Ranges: Thermal diffusivity: 0.001 to 10 cm²/s, Thermal conductivity: 0.1 to 2000 W/mK. (208 Rhines)



JOEL NeoScopeBenchtop SEM –Scanning electron microscope with magnification is from X10 to X40,000. It has accelerating voltages of 15 kV, 10 kV, and 5 kV in a 3-position switch. High and low vacuum modes. Secondary electron and backscattered electron imaging. Sample loading to imaging in less than three minutes. (208Rhines)



Keithley Picoammeter (6487) - Measures currents ranging from 20fA to 20mA, takes up to 1000 readings per second, and source voltage from 200μV to 505V. (208 Rhines)



Tektronix TBS1022 2 Channel Oscilloscope – This instrument is used to observe the change of an electric signal over time. This model is a 2 channel oscilloscope with a 500 MS/s sample rate and a 8 bit vertical resolution. (208 Rhines)



Precision LCR meter (Agilent E4980A) –Used to measure inductance, capacitance and resistance of a sample/component. Frequency range of 20 Hz to 2 MHz. (208 Rhines)



Precision Impedance Analyzer (Agilent 4294A) - Frequency range of 40 Hz to 110 MHz. (208 Rhines)



Agilent Technologies E5071B- A network analyzer measures RF components within the frequency range of 300 kHz - 8.5 GHz. (208 Rhines)



Precision Semiconductor Parameter Analyzer Agilent 4156C
- Bench top solution for advanced device characterization. The superior low-current and low-voltage resolution and built-in quasi-static CV measurement capability of the 4156C provide a firm foundation for future expansion with other measurement instruments. The 41501B Expander extends your capabilities to 1A/200V and add a low noise ground unit and dual pulse generators on the 4156C. (208 Rhines)



Stanford Research System model PS 350/5000V-25W
- This is high voltage power supply (Voltage range: 50 – 5000 V, Maximum current: 5 mA, Voltage resolution: 1 V, Voltage resettability: 1 V). (208 Rhines)



SI 1260- A Solartron impedance/gain-phase analyzer. Frequency range from 0.1 Hz to 32 MHz. (208 Rhines)



Delta Design 9023 Environmental Test Chamber—Allows for precise temperature control within the range of -180°C to 315°C. (208 Rhines)



Agilent 33220A- A function/arbitrary waveform generator (with AM, FM, PM, FSK, and PWM) modulation types create frequencies within a range of 20 MHz–1 μ Hz. (208 Rhines)



Agilent 16452A Liquid Test Fixture—Provides accurate dielectric constant and impedance measurements of liquid materials. The fixture allows you to make frequency swept measurements or temperature coefficient measurements that precisely characterize liquid materials. (208 Rhines)



Agilent 85033E Calibration Kit- The Agilent 85033E calibration kit contains precision 3.5mm standards used to calibrate Agilent network analyzers. Standards include fixed terminations, open circuits, and short circuits in both sexes. A torque wrench is also included for proper connection. This kit is specified from dc to 9 GHz. (208 Rhines)



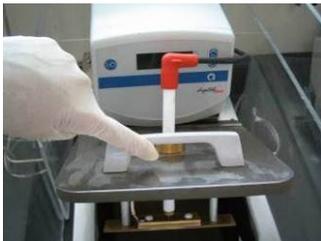
Programmable Current Source- A Keithley current source with a full range current from 2 nA to 100 mA and selectable voltage compliance of up to 105 V (in 1 V increments). (208 Rhines)



Digital Multi-Meter (2)- The Agilent 34401A has a 6.5 digit display and can be used to measure DC/AC voltage, DC/AC current, 2 and 4 wire resistance, diode, continuity, frequency and period. (208 Rhines)



Piezoelectric Meter- The PM3500 is manufactured by KCF Technologies and enables d_{33} and d_{31} measurements. The 90-2030 model from APC Ceramics Inc. measures a wide-range of 1-2000 pC/N, accommodates various sizes and shapes, and can determine polarity. (208 Rhines)



Poling Bath- A high voltage device is connected to a NESLAB EX-7 Digital Plus Heating Bath Circulator in which a sample can be poled within the temperature range of 12°C to 200°C. (208 Rhines)



Voltage Source (2)

- Acopain High Voltage Supply (208 Rhines)
- Series EL is made by Glassman High Voltage, Inc., and it has 40-45 Watt Regulated High Voltage DC Power source. (256Rhines)



Ferroelectric Characterization- The hysteresis curves are extracted from this custom made high voltage source (max 4 kV) and measuring apparatus. (208 Rhines)



Custom Made Quartz Reactor - Design allows the maintenance of different atmospheres (partial pressures of hydrogen) on the opposite sides of the sample required for proton transference number measurement. A thermocouple located close to the sample minimizes error in temperature measurement. The reactor is also used for variable atmosphere conductivity measurement as a function of temperature. (208 Rhines)



Benchtop Microprobe Station- from Micromanipulator (450 PM Test Station) CO., Inc. is a manual analytical probing test station which allows the probing of very small semiconductor geometries. It is available with and 8" chuck and 8 inch by 8 inch stage translation. (208 Rhines)



HeatPad™ Microheater -Rapid heated area (1 inch size) up to 1200°C (measured at internal thermocouple). Low heater profile enables localized heating, substrate heating, vacuum environments and high pressure environments. (208 Rhines)



Peltier-Thermoelectric Cold Plate Cooler - from TE Technologies, provides effective, direct-contact cooling for small heat loads at low temperatures. The plate temperatures can be cooled down to below -20°C. (208 Rhines)



Cryo-refrigerator - Temperature from 15 K to 500 K can be achieved, with 4 BNC connectors that can be connected to electrical characterization equipment such as LCR. (208 Rhines)



Nitrogen Dewar - MVE - Lab 5- Container used for storing of liquid nitrogen. Net capacity is 5 Liters, static evaporation rate is 0.15, neck opening of 2.2 inches, overall height of 18.2 in. (208 Rhines)



EDAX Inc. Micro-XRF Elemental Analyzers -A compact, tabletop instrument used for elemental analysis based on X-ray fluorescence (XRF). It features fast, simultaneous, non-destructive sample analysis with little or no sample preparation for most materials. (125 NSC)



Nikon Eclipse LV100- A polarizing optical microscope with 5 objectives ranging from 4x to 100x giving a magnification of up to 1000x. (208 Rhines)



Optical Microscope - The Meiji EMZ 13TR Stereo Microscope also includes digital capture and a wide range of magnifications from 60X to 420X. (208 Rhines)



Konica Minolta CM2600d Photospectrometer - Used to measure the precise color of a sample using a variety of standardized color coordinate systems. (208 Rhines)



Digital Comparator - Mitutoyo thickness meter with an accuracy of ± 0.001 mm. (256 Rhines)



Single Crystal Orientation Device – The EQ-DX-100G (MTI Corporation) is a desktop X-Ray diffractometer used for analyzing the orientation of single crystals in a 2θ range from 10° - 140° . (208 Rhines)



Simultaneous TGA/DSC – The SDT Q600 provides simultaneous measurement of weight change (TGA) and true differential heat flow (DSC) on the same sample from ambient to 1500°C in air or gas-controlled atmosphere. (208 Rhines)



Fisher Scientific Traceable Expanded Range Conductivity Meter – Used for checking the purity of water from stills, deionizers, and reverse osmosis, testing laboratory glassware rinsing, measuring total dissolved solids, and making solutions. (256 Rhines)



Fluke 289 True-RMS Industrial Logging Multimeter – High-performance multimeter capable of measuring AC/DC voltage, AC/DC current, temperature, resistance, capacitance, frequency, connectivity

- Two terminal $50\ \Omega$ range with $1\ \text{m}\Omega$ resolution, $10\ \text{mA}$ source current
- True-RMS AC voltage and current for accurate measurements on non-linear signals.
- Current range: $500\ \mu\text{A}$ – $10\ \text{A}$
- Capacitance range: $1\ \text{nF}$ – $100\ \text{mF}$
- Voltage range: $50\ \text{mV}$ – $1000\ \text{V}$

(208 Rhines)



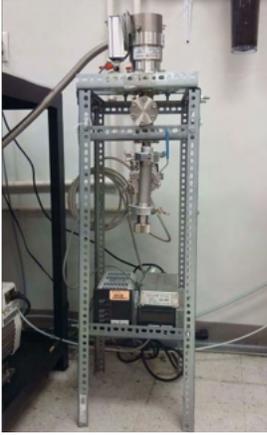
Fungilab Viscolead Pro Viscometer R –Measures relative and absolute viscosity, small sample adapter measures 8-13 mL volume solution. Direct readout; Speed: 0.01-200 rpm, Range:100-40,000,000 cP. (256 Rhines)



Keithley Model 2450 SourceMeter - benchtop Source Measure Unit (SMU) instrument. Acts as power supply, current source, DMM, electronic load, and trigger controller. (208 Rhines)



NANOpure Water purification system – This is used to purify the water (256 Rhines)



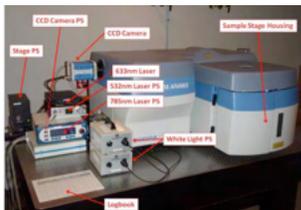
Glass ampule sealer – This device seals glass ampules. (208 Rhines)

Equipment in Other Research Facilities

Nano Research Facility (NRF)

The NRF is in the heart of the UF campus just off Center Drive. This site has low intrinsic vibration properties and it is located far from any detrimental sources of electromagnetic interference (EMI) – both essential requirements for any nanoscale research facility. The NRF is a two-story building with seven functional areas: 1) A Class 100-1000 cleanroom facility for nanofabrication and bio processing. 2) Advanced electron, optical, and surface imaging laboratories. 3) Core research laboratories for /synthesis, processing, characterization, assembly, and testing of nanoscale materials, devices and sensors. 4) General laboratory space for interdisciplinary research collaborations. 5) Offices for faculty, staff and users. 6) Interactive spaces for conferences, informal gatherings, user administration, and surroundings conducive to multidisciplinary interactions. 7) Building support and utility handling areas.

The Class 100-1000 cleanroom facility is a folded bay-and-chase layout on the first floor with 7 research bays, a tool move-in aisle, and a gowning area. The research bays are: a) E-Beam Lithography; b) Bio/Nano Biological, Soft Lithography and Medical Research; c) Photolithography; d) Wet Processing; e) Hot processing; f) Thin Films Deposition; and g) Dry Etching. Key equipment available for the entire duration of the project include:



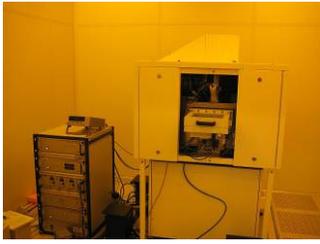
Horiba LabRAM Aramis - A multi-wavelength (325, 532, 633, and 785nm) Raman system with mapping capabilities, confocal pinhole, and multiple grating selection.



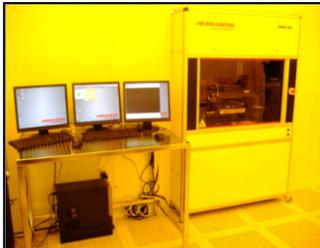
Profilometer - The Dektak 150 is a stylus profilometer which can measure step heights and surface roughness by measuring deflections of the diamond-tipped stylus as it is dragged across a surface.



Sputter Deposition, KJL CMS-18 Multi-Source - Combinatorial Materials Science thin film sputtering system. 4 gas injected Magnetron sputter sources.



Raith 150, e-beam lithography -The RAITH150 is a multipurpose tool capable of direct e-beam exposure, wafer scale process development at suboptical resolution. The system includes integrated linewidth and metrology functions which give the user the ability to optimize process reproducibility.



Heidelberg DWL66fs Laser Writer-Heidelberg DWL 66FS Maskless Laser Lithography System. The DWL 66FS is a high precision, maskless pattern generator for direct laser writing of photosensitive materials at 405nm. Substrates may be masks, silicon, glass, etc. as long as it is relatively flat.



PVD E-beam evaporator – Used to deposit layers of atoms on the surface of a sample using a beam of electrons to evaporate the source material and coat all things within a vacuum chamber (sample included). This particular PVD has a 4 pocket 15cc e-beam, a 3” DC sputter source, and a substate heater



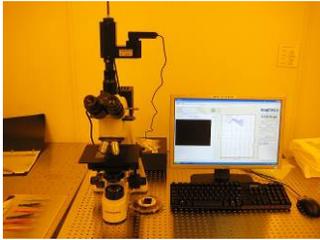
PECVD, STS 310PC-The PECVD STS deposition tool is used for depositing silicon nitride, silicon dioxide and amorphous silicon films. The system is equipped with 13.56 MHz and 187.5 kHz frequencies and is capable of mixed frequency recipes. The temperature of the system is normally kept at 300 °C.



Cambridge Nano Fiji 200 ALD-A-A loadlocked ALD system with thermal and plasma deposition capabilities, 3 metal-organic precursors and up to 8" wafer sample size. The system is capable of operating in "exposure mode" which allows for deposition in high aspect ratio features.



JEOL 5700 Electron Microscope-The JEOL CarryScope is a compact and portable SEM that utilizes a standard tungsten filament. The CarryScope is capable of imaging from 8X to 300,000X and up to 5nm resolution. Accelerating voltage can be varied from 5kV to 20kV and the beam diameter can also be adjusted. It features manual XYZ stages with full 360° rotation and -10° to 90° tilt and can hold a full 4" wafer.



Filmetrics F40 Photospectrometer-The Filmetrics F40 is used to measure the thickness and optical constants (n&k) of dielectric and semiconductor thin films. Measured films must be optically smooth and within the range of 30Å to 40µm. Transmission-vs- wavelength can also be measured if substrate is transparent.



Raith ionLINE- multi-species FIB-The Raith ionLINE is a focused ion beam (FIB) lithography system with a Liquid Metal Alloy Ion Source (LMAIS) rather than traditional Ga for exposure, milling, and implantation.



Steag RTA 100CS RTP-Atmospheric Rapid thermal anneal to 1050°C. Gases available are: N₂, H₂+N₂, O₂. Process time is limited to 10 minutes.



Anatech Barrel Asher SCE600-Uses an oxygen plasma for stripping photoresist, descum, surface cleaning, and surface treatment. Can process up to 25, four inch wafers at one time. Max power is 600W.



STS Deep RIE—Used to modify the physical properties of a target using a plasma. This process is essential in the fabrication of integrated circuits. The STS DRIE is an Inductively Coupled Plasma Process etcher designed and configured to etch deep high aspect ratio features in silicon only. The process provides high selectivity for etching Si with most common Photoresist and SiO₂ masks.



Unaxis SLR RIE/ICP—Unaxis Shuttlelock Reactive Ion Etcher with Inductively Coupled Plasma Module. Etch Capabilities: SiO₂, Si₃N₄, photoresist, polyimide, Al, dielectrics and other commonly used materials. Features: - Process Gases Available: SF₆, CL₂, BCL₃, CHF₃, O₂, Ar, H₂, CH₄, N₂ -Wafer Clamping and He backside cooling. 4" and 5" wafer capable. 3" and 6" capable with purchase of additional wafer clamps. -Temperature controlled chamber - 2KW ICP, 600W RIE -Automatic wafer load via load lock.



Lakeshore 7507 Electronic Measurement—The Lakeshore Hall Measurement System capabilities include Hall coefficient, Hall voltage, resistance, resistivity, magnetoresistance, I-V curves, carrier concentration and mobility.



J.A. Woolam Ellipsometer—The ellipsometer is able to measure the refractive index and the thickness of semi-transparent thin films. It can be used to measure layers as thin as 1 nm up to layers which are one micron thick. Applications include the accurate thickness measurement of thin films, the identification of materials and thin layers and the characterization of surfaces.



ADT Dicing Saws-Fully automatic programmable dicing saw.



K&S 4124 Ball Bonder-Used to make an electrical interconnection between a chip and a device. Used as a part of semiconductor device fabrication. The K & S Model 4124 gold wire ball bonder has the capability of wiring dies to packages or PCBs in a precise and regular pattern. It is stocked with fine pitch capillaries and one Mil pure gold wire.



Coulter LS320- B measures particle size from 40 nm to 2mm by laser light scattering (LS). This instrument has three sample modules: a Universal Liquid Module, a Micro-Fluid Module and a Dry Powder Module (DPM). Samples in both powder and liquid form can be measured.



Quantachrome Porometer 3G-zh - Measures pore sizes using a liquid expulsion technique. The pore size distribution that the system measures is in the range of 500 μ m down to 18nm. The pressure used to measure these pore sizes is 500psi.



Quantachrome Autoscan 60 Mercury Porosimeter - Measures open pore size distribution with pore radii varying from ~100 μ m to 1.8 nm for unconsolidated and consolidated particulate materials. Mercury is used at high pressure to determine the pore size.