

UNIVERSITY OF SOUTH FLORIDA

The Nanomaterials and Nanomanufacturing Research Center (NNRC) is a university-wide user fabrication and metrology center providing state-of-the-art equipment, professional support personnel and infrastructure to enable multidisciplinary research in nanomaterials and nanomanufacturing methods related to fundamental materials science, sensors, actuators, electronics, bio-systems, medical products, optics and integrated nanoscale systems. The Nanotech I facility supports research projects of faculty, graduates students, undergraduates, and industrial researchers. Research areas include: nanomaterials and nanomanufacturing methods related to fundamental materials science, sensors, actuators, electronics, bio-systems, medical products, optics and integrated micro and nanoscale systems. The Nanotech 1 (NTA) building is located on the University of South Florida Campus.

NNRC has 1,250 sq .ft of clean room space fully equipped with fabrication and characterization equipments. The resources of this center include tools for thermal processing (BTI furnace bank, LPCVD, RTA), plasma processing (deposition, RIE, RF & ECR deposition and etching tools), thin film processing (e-beam and thermal evaporators), lithography (double sided mask aligner, dual track spin system, Nanometer Pattern Generation System equipped JEOL 840 SEM e-beam lithography), Characterization/metrology tools include s800 Hitachi- SEM and EDX, Philips XRD pro, Nanoscope AFM, A high resolution TEM and FIB from FEI was secured recently with funds from NSF-MRI. Additionally a Adixen DRIE was recently procured for Silicon as well as insulator etching.

The Bio-MEMS and Microsystem laboratory (SB) has about 1000 sq.ft of clean space equipped with state-of-art Cascade Microtech Summit 11562 Probe Station with Atto Guard protection in conjunction with Agilent 4294A(40-110MHz) Precision Impedance Analyzer dedicated exclusively for characterization and testing of bio-sensors. The lab is also equipped with a gas sensing test bed with four mass-flow controllers (for analyzing different gases), current sources (Keithley 2400 SMU) and multimeters, controlled by LabView software. It is also equipped with an three gun RF/DC sputtering system, electron beam and thermal evaporator, thickness profiler, wafer dicer, high temperature oxidation furnace, annealing furnace, photo-reduction facility, double-sided mask aligner, wet chemical benches, wafer lapping, thermal bonding, wire bonding, pick and place assembly, various frequency counters, digital multimeters, programmable power supplies and pico ammeter. We have recently purchased a fully programmable four-electrode potentiostat/galvanostat system for electrochemical studies.

The Dr. Peter Zhang has three modern research laboratories with a total of 1800 sq ft space in the Bio-Science Building at USF. The laboratories have a total of 12 fume hoods and are equipped with the standard synthetic facilities. There are one HPLC system, one Julabo immersion cooler, three high-vacuum line systems, and five solvent still assemblies. One GC/GC-MS system and other instruments are located in a separate instrument room near to the laboratories. In addition, a shared solvent room is also available for storage of solvents and related chemicals.

The University of South Florida's **Thin Film Electronic Materials Laboratory** has been under the direction of Drs. Chris S. Ferekides and Don L. Morel since 1991. The 3,400 sq ft facility is dedicated to the deposition/fabrication and characterization of thin films and devices. Solar cells

and other thin film devices can be fully fabricated and characterized. The list provided below describes the major equipment present in the Thin Film Electronic Materials Laboratory.

Laboratory for Microwave Circuit Fabrication and Testing: The Wireless and Microwave Research Laboratory has 1000 square feet of space and capabilities for DC, power spectrum and S-parameter measurements to 110 GHz (see Characterization under Major Equipment below). The MEMS/MMIC Laboratory has 1200 square feet of space and facilities for thermal and electron beam deposition, RF and DC sputtering, parylene deposition, wafer cutting, wafer lapping, thermal bonding, wire bonding, pick and place assembly, wet processing, plasma etching, and inspection.

The newly established Thin Film Metrology Laboratory has 800 square feet of space and state-of-art equipments for thin film material characterization, such as Atomic Force Microscope (AFM), Hall Effect measurement system, Nanoindenter, Fourier Transform Infrared Spectroscopy (FTIR), I-V & C-V measurement probe station, vector network analyzer, and on-wafer microwave probe station

Computational Facilities:

Academic Computing at USF supports the Research Computing Core Facility (RCCF), which will provide the necessary computing power for the simulations described in this proposal. RCCF support several multi-processor SUN servers and Beowulf clusters with parallel processing compilers. Recently we have added a 120 node beowulf cluster paid for by a \$500K NSF-MRI grant. Each node, a SunFire x4150, contains two Quad-Core Xeon X5460s, 16GB of RAM, and is connected via InfiniBand. We will have full access to this new, large cluster to perform detailed molecular level modeling and simulation. Additional computing facilities beyond common desktop systems include 64 bit SUN workstations for setting up computational intensive simulations and performing smaller scale simulations. The USF College of Engineering administers a number of server class computers: an 8-processor Sun Enterprise 3500 for UNIX applications, a dual-processor Sun Enterprise 250 as a mail exchanger, a quadprocessor Sun Enterprise 420R as a file server for the UNIX workstations, a pair of Sun Ultra 10s for serving the student and faculty web pages and database research.

RCCF also has license for VASP, Gaussian and GAMESS(for electronic structure calculations), DL-POLY (for molecular dynamic simulations) , FEMLAB and ANSYS (for finite element simulations) and other software packages for numerically intensive computing applications.

The College of Engineering operates 4 modern teaching and open-access labs for students use. These labs are equipped with large number of fast computers. The labs are equipped as follows: ENB116 - 39 Dell Pentium III, 866Mhz with 256Mb of Ram, 40Gb hard drive, CD-RW and flat panel displays. Instructor's station with projection of instructor computer screen and other material via an Elmo document camera. ENB118 - 39 Dell Pentium III, 350Mhz, 128Mb Ram, 6Gb hard drives and CD ROM. ENB228 - 26 Dell GX400 1.4Ghz with 256Mb Ram, 40Gb hard drives, CD-RW and under desk 17" monitor. Instructor's station connected to overhead projector and linked to a "Smart Board" touch screen system. ENB229 - 26 Dell GX1P 500Mhz with

128Mb Ram, 10Gb hard drive and CD-Rom drives. These labs are networked with E-mail and Internet access. College also supports a multimedia lab with document scanners and CD-ROM burner.

State-of-the-art optimization software, including Gurobi V 2.0 and CPLEX V 12.0, and discrete event simulation system, Arena V 11.0, are available through the computer lab of Industrial and Management Systems Engineering. Those software and systems will provide the analytical tools and computing facilities for system level analysis, optimization and decision support.

Network

The college-wide Ethernet network is connected to the USF campus-wide Gigabit Ethernet backbone. Within the College connections are provided to faculty offices and laboratories via fast 100 Mbps net. Our Internet2 connection links USF to more than 140 major universities and research institutions in the nation. Dial-in access is available to faculty and student from a large USF modem bank. The FEEDS studios are also networked to provide computer demonstrations for remote classes. Additionally, each department has its own computing lab(s).

Machine Shop & Technical Support

The College of Engineering is also supported by a Machine shop; Electronics/Electrical support staff; Environmental Health & Safety Department; Physical Plant; and there is a Glass company close to USF.

USF - Clean Energy Research Center

CLEAN ENERGY RESEARCH CENTER (CERC): The Clean Energy Research Center (<http://cerc.eng.usf.edu>) at the University of South Florida has been working in the broad areas of HVAC, Energy Efficiency, Solar Energy, renewable hydrogen production, hydrogen storage and fuel cells. The mission of the center is to develop, evaluate and promote commercialization of new environmentally clean energy sources and systems such as, that meet the needs of the building HVAC, electric power and the transportation sector through multi-disciplinary research, technical and infrastructure development and information transfer. The Center supports regional economic development of manufacturing and high technology business, in conjunction with the National goals of improving our global competitiveness and technology leadership. CERC has been awarded more than 15 millions in contracts and grants over the past 10 years. The CERC team comprises of 20 affiliated faculties from different disciplines (Electrical, Chemical, Mechanical, Industrial, Computer Science, Physics, Chemistry) of USF, staff and 20 graduate and undergraduate students.

List of available equipment (CERC-USF) for the proposed research are given below:

1. Recirculating Duct Air Conditioning loop for HVAC and Indoor Air Quality Research
2. A/C refrigerant reclaiming and charging equipment.
3. Low temperature cooling bath, (-20 °C), Thermo Corporation
4. Data acquisition systems (Iotech) with sensors to monitor and collect data, including temperature, humidity, solar radiation, voltage, current, and power.
5. Fabrication shop including lathe, milling machine, drill press, sheet metal tools, hand and power tools for working with metal, plastics and wood.
6. High Energy Ball mill (Fritsch Pulversette-6) for the synthesis of nanocatalysts doped complex composite hydrides
7. Vacuum, inert or solvent mediated milling with automated control mechanism
8. Tube furnace (Lindberg) that can operate up to 1000° C; provision for various reactive and inert gas process
9. N₂ filled dry glove box attached with solvent purification system (Innovative Technology Inc.) for the material preparation, doping etc.
10. Schlenk vacuum manifold for sample purification and filtration procedures (www.ars-fla.com)
11. Ultrasonic bath for wet chemical preparation and filtration of complex hydrides; Spray pyrolysis for thin film fabrication
12. FTIR spectrometer- Spectrum 1 (Perkin-Elmer) with a wavelength range or 400-3000 cm⁻¹
13. UV-Visible (Ocean Optics) spectrometer that can operate in absorption, transmission and reflectance modes
14. BET/Thermal Programmed Desorption (TPD) from Quantachrome instruments for measuring the surface area, pore size volume and thermal conductivity
15. DSC/TGA from TA Instruments for the thermal stability measurements and weight loss analysis
16. High pressure automated hydrogen sorption system for full kinetics, PCT and cycle life measurements (HyEnergy LLC)
17. Weighing balances and ovens and related accessories
18. Gas and Liquid N₂ handling systems
19. Gas Chromatography, SRI Instruments Inc.
20. Hydraulic Pelletizer (10000 psi), International Crystal Laboratories