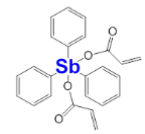
Descriptions of 2020 SURP Positions Available on the Albany Campus of SUNY Poly

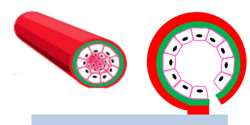
Seventeen Professors and 32 Positions

Professor Robert Brainard, RBrainard@SUNYPoly.edu

1) **Molecular Organometallic Resists for EUV (MORE).** Metal-based resists for use by the microelectronics industry to fabricate future integrated circuits. Students will synthesize and/or characterize compounds containing main-group metals. These compounds are designed to undergo chemical reactions when irradiated with 13.5 nm extreme ultraviolet light resulting in a change in solubility. **Student Background:** No experience necessary, but strong background in chemistry, particularly organic chemistry. Rising sophomores welcome.



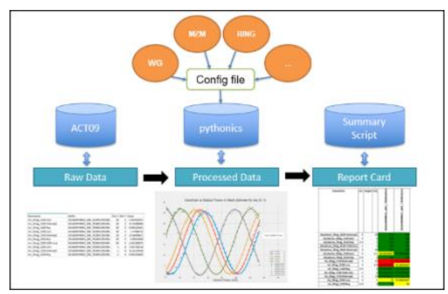
2) **Bio Roll Up.** The design and synthesis of organic polymers and photoresists focused on a technique designed to engineer small organelles in the human body. Students will synthesize polymers and formulate polymers into photoresists, that will be coated onto silicon wafers into multiple stacks of hydrogel films. Students will study the kinetics of self-assembly of these multi-layer stacks under conditions suitable for cell growth. Students may participate in growing cells onto these stacks. **Student Background:** No experience necessary, but strong background in chemistry and biology required. Rising sophomores welcome.



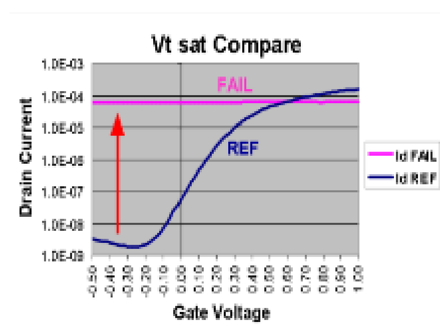
3) **Nano-Structured Polymers.** The goal of this project is to design and synthesize polymers with specifically-designed nanoscale morphology for microelectronics applications **Student Background:** No experience necessary, but strong background in chemistry, particularly organic chemistry. Rising sophomores welcome.
4) **High-Resolution Lithographic Process for Microelectronics.** This project would require a student to design, synthesize and evaluate molecules that would be used in a process to produce high-resolution patterns. Ultimately, the goal of this project will be to develop a process can be used to manufacture integrated circuits. **Student Background:** No experience necessary, but strong background in chemistry, particularly organic chemistry. Rising sophomores welcome.

Professor Chris Borst, Nicholas Fahrenkopf, nfahrenkopf@sunypoly.edu and Sweta Pendyala spendyala@sunypoly.edu

1) **Python Coding for Photonics Test Data Collection and Analysis Intern (Fahrenkopf):** The Fahrenkopf AIM photonics group is currently scaling up a wafer scale integrated photonics test environment. Looking for a student interested in semiconductor technology and photonics be an integral part of script/software development in test automation, GUI, and big data analysis. Possible hands-on contribution to the build of a die-level edge-coupled testing apparatus.
Student Background: Engineering, Physics, Computer Science.



2) **Inline Test and Failure Analysis Intern (Pendyala):** The inline test and FA team is focused on testing and debugging the leading edge memory and custom wafer designs at SUNY Poly. Looking for a student to work with the Test & FA team and the integration teams at to create a test program to plot electrical data and to debug the new yield management system. The test program should be able to process the data (input in .csv or .txt format) and generate plots and perform calculations to generate Vt tables. **Student Background:** Candidate should have an interest in computer science / data science and have a good understanding of MOSFET electrical characteristics. Experience with writing macros using MS Excel or with analyzing data using JMP or R is a plus.



Professor Nathaniel Cady, ncady@sunypoly.edu

1) **Neuromorphic Computing**. The Cady research group is focusing on the development of novel chips that are customized for neuromorphic computing applications, based on memristor (resistive memory) technology. The student working on this project will be involved in the testing and/or simulation of these chips at the SUNY Poly site in Albany, NY. **Student Background:** background/experience in electrical engineering, computer engineering, or computer science.
2) **Lyme Disease Biosensor.** The Cady research group is developing biosensors for diagnosing Lyme disease at early stages of infection. The intern on this project will assist with optimization and validation of the sensor platform that we are developing. **Student Background:** Interest in biology, and can have background in biology, chemistry, or an engineering field. It is preferred that the student researcher have prior hands-on laboratory experience.

Professor Greg Denbeaux, gdenbeaux@sunypoly.edu

1) **Low energy electron exposures of resist.** We are working toward an understanding of the low energy electron interactions in photoresists for EUV lithography. This summer, our goal will be to test and implement improvements to the power supply and low energy electron gun to get electron energies below 5 eV for exposures of the EUV resist. The primary product will be measurements of the outgassed molecules as an indicator of the chemical reactions that have occurred due to the exposure. Understanding the low energy response of these materials will help in the optimization of better performing, more efficient photoresists for the semiconductor industry. **Student Background:** background/experience in electrical engineering, physics, or materials science preferred.
2) **Nanoparticle measurements from vacuum components.** The ability to detect nanoparticles is of critical importance to the semiconductor industry since the particles landing on the wafers can cause defects and affect the yield of the process. We are working on techniques for measuring particles in vacuum systems. The student will work with particle measurements of valves for vacuum systems and custom measurements of the defect generation within turbo pumps.
   Student Background: background/experience in physics, or materials science preferred.

Professor Alain Diebold adiebold@sunypoly.edu

1) **Spectroscopic Ellipsometry and Scatterometry of Semiconductor Structures.** The student will learn to measure thin films and nanoscale patterned structures using Mueller Matrix Spectroscopic Ellipsometry and begin to learn how to determine the structure shape and dimensions using scatterometry. The student will also have the opportunity to learn how to measure chemical and structural information using other materials characterization methods. **Student Background:** previous experience working with ellipsometry as well as a background in physics.

Professor Kathleen Dunn, kdunn1@sunypoly.edu

1) **In situ purification of FEBID Pt deposits for Additive Nanomanufacturing.** Platinum nanostructures created via Focused Electron Beam Induced Deposition may have as much as 60% carbon incorporation from the metalorganic precursor and residual hydrocarbons in the reaction chamber. For many additive nanomanufacturing applications, however, a purer product is desired. This project explores the use of water vapor as a co-reactant with the standard Pt FEBID precursor in a variable pressure (environmental) scanning electron microscope as a means of athermally producing higher conductivity metallic Pt deposits. Project may include installation of new/modified hardware and pattern generation software. **Student Background:** Engineering or physical sciences preferred.
2) **Hydrothermal synthesis of nickel ferrite as model corrosion product.** In many high temperature corrosive environments, steel parts slough off nickel ferrite particles which cause wear and damage to delicate systems. The interaction of these particles with each other and surfaces of interest depend on size and stoichiometry, but studying them in the field is complicated by the aggressive conditions under which they form. The Dunn group therefore synthesizes model particles in a lab-scale hydrothermal reactor, modifying the cation ratio and process conditions in order to have an accessible supply for subsequent analysis. Project would include synthesizing particles, sizing and crystallographic analyses, and could also include defect, adhesion or other characterization. **Student background:** inorganic chemistry, physics, or materials science preferred.

3) **Electrochemical deposition of copper alloys.** Copper alloys find use in a wide variety of industrial applications, but understanding of their behavior is largely empirical because the microscopy and spectroscopy tools with requisite atomic resolution have not been widely available until recently. SUNY Poly has such instruments available, and the Dunn group is using them to understand how the presence of solutes at defects in the copper matrix changes the electronic band structure in the vicinity of the defect, leading to macroscopically observable changes in material behavior, such as increased strength or reduced ductility. This effort requires the development of new recipes for electrochemical deposition of the alloys, compositional analysis of the resultant films, and microstructure determination. **Student background:** chemistry or materials science preferred.
4) **Rapid screening for materials development** (with Professor Bradley Thiel). There is a pressing need to develop new materials with enhanced properties that can be robustly synthesized and integrated into device design and manufacturing. The linking of materials structure, properties, processing, manufacturing, and performance attributes is required for fundamental discovery of new materials. Exploring this link represents a bottleneck in the adoption of new materials for advanced manufacturing. This project employs a combinatorial deposition approach for rapid screening of candidate material systems, coupled with SEM-based analytical techniques to correlate composition with local electrical properties (such as resistivity and bandgap), microstructure, and defect populations. **Student background:** materials science preferred.

Professor Harry Efstathiadis, hefstathiadis@sunypoly.edu

Not taking external (non-SUNY Poly) students.

1) **Development and testing of ionic conductors for solid electrolyte batteries.** The fast expansion of Li-ion batteries with liquid organic electrolytes among other problems created many safety issues when operating at high voltages and/or elevated temperatures. A possible solution to this problem is to use solid state electrolytes instead of liquid. One such promising solid electrolyte is Lithium Aluminum Titanium Phosphate (LATP) or other non-lithium based electrolytes. The stability and conductivity of LATP films will be studied and the electrochemical performance of cells will be evaluated. Thick LATP films in the order of several micrometers show ionic conductivity in the order of ~$3x10_{-6}$ S cm-1, excellent long-term stability in contact with lithium, and have been incorporated as solid electrolyte into Li-ion batteries and other devices, such as electrochromics. Even though the advantages of LATP as a solid electrolyte have been demonstrated, the influence of sputtering deposition parameters on the composition and the ionic conductivity is not yet known. In this work the influence of sputtering deposition parameters on the composition and the ionic conductivity of LATP will be investigated. Several coin cells will be assembled in an inert environment and they will be evaluated. Focus will be given in characterizing the solid electrolyte interface **Student Background:** Nanoscience, and nanoengineering.

Professor Michael Fasullo, MFasullo@SUNYPoly.edu

1) **Mechanisms of carcinogen resistance by error-free DNA damage tolerance mechanisms.** Metabolic activation of carcinogens generates mutations in tumor suppressor genes. We have profiled the yeast genome for resistance to a potent liver carcinogen, aflatoxin B1 (AFB1) and to heterocyclic aromatic amines (HAAs). We identified novel genes that are involved in both HAA and AFB1 resistance and that included DNA damage tolerance genes. Currently, we are now determining the mutagenic profile of these food carcinogens. This project will explore novel genetic mechanisms by which food carcinogens cause mutations using next generation sequencing technology. **Student Background:** Chemistry and Biology.
2) **Bioinformatics of profiling the yeast genome for carcinogen resistance.** We have profiled the yeast genome for resistance to several potent carcinogens, including heterocyclic aromatic amines (HAAs). We have performed computational processing of high throughput data to determine statistical significance and gene ontology groups based on function, process, and pathway. The project will explore different computational methods for processing high-throughput data. **Student Background:** Math, Computer science, and Biology.
3) **Correlating changes in cellular deoxynucleotide concentrations and resistance to DNA damaging agents and oxidative stress.** Deoxynucleotides (dNTPs) are the building blocks of DNA and are required for unscheduled DNA synthesis that occurs in DNA repair. We have previously identified yeast mutants that are defective in the induction of dNTPs after cells are exposed to DNA

damage. This project will involve correlating DNA damage resistance and cellular levels of dNTPs. **Student Background:** Chemistry and Biology.

Professor Spyros Gallis, sgalis@sunypoly.edu

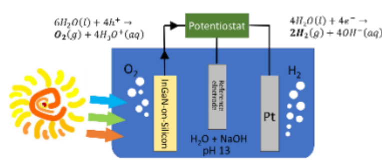
Student researchers will work with senior graduate students and will be exposed to advanced synthesis, nanofabrication, and characterization techniques.
https://sites.google.com/sunypoly.edu/galisresearch/research

1) **On-Demand CMOS-Compatible Fabrication of Self-Aligned Nanostructures.** We will develop new scalable silicon carbide (SiC) nanostructured materials for use in a plethora of emerging applications, such as nanowire-based sensing, single-photon sources, and quantum photonics. We will investigate how synthesis, integration methods, and critical factors (e.g., nanostructure geometry, defect density) affect the optical and electrical properties of these deterministically fabricated SiC nanowire arrays. **Student Background:** Materials Science and Engineering; Electrical Engineering.
Additional info: https://www.mdpi.com/2079-4991/8/11/906
2) **Scalable Nanophotonic Structures for Long-Distance Quantum Communications.** The Galis (SGNano) research group is developing novel rare-earth doped nanostructures for telecom quantum communication applications. The underlying theme is to design and fabricate nanophotonic structures to modify the local electromagnetic environment of rare-earth ions, thus changing their emission rate and radiation distribution. Theory and modeling will be employed to investigate the effects of synthesis, doping, and the geometry of these nanophotonic structures on their emission properties. **Student Background:** Physics; Engineering. **Additional info:** http://arxiv.org/abs/1707.05738
3) **Polarization-Dependent Nanophotonic Devices.** We will study new chemical strategies to the surface treatment of pseudo-one-dimensional gallium telluride (GaTe) nanomaterials to ensure effective surface passivation against environmental oxidation. We will study and develop different designs of GaTe-based layered nanodevices for applications in polarization-sensitive devices, such as polarized photodetectors. We will leverage passivation to obtain the time-evolution physical properties of these GaTe nanosystems (e.g., polarization-dependent light-matter interactions, defect-related photoluminescence). **Student Background:** Physics; Materials Science and Engineering. **Additional info:** https://www.mdpi.com/2079-4991/9/11/1510

Professor Iulian Gherasoiu, gherasi@sunyit.edu

Not taking external (non-SUNY Poly) students.

1) **Resilient Water Splitting Cell for Hydrogen Generation.** Most of the photoelectrochemical (PEC) cells have a surface that is easily oxidized and corroded affording a lifetime of only a few hours before the hydrogen generation stops. The project continues the development of a corrosion resistant and efficient PEC water splitting cell having the ability to spontaneously dissociate water under solar AM1.5 illumination. The focus of the project will be on the synthesis of the corrosion-resistant film using PE-CVD system and doping of the film followed by the characterization of its optoelectronic properties.
2) **Student Background:** background in electrical engineering, physics, chemistry or materials science preferred.



Professor Mengbing Huang, mhuang@sunypoly.edu

Not taking external (non-SUNY Poly) students.

1) **Magneto-Transport in Si and Ge with Embedded Magnetic Particles.** The project is designed to investigate the magneto-transport properties in Si and Ge crystals containing embedded magnetic nanostructures, with the aim to explore viable mechanisms for developing novel devices in these important semiconductor materials for quantum information processing and quantum computing. Magnetic nanostructures will be formed within Si and Ge using an ion beam method, and their effects on semiconductor band structures and electron spin transport will be assessed with low-temperature magnetoresistance measurements for various magnetic field strengths and orientations. Student background: Physics, Electrical Engineering, Materials Science.

Professor Vincent LaBella, vlabella@sunypoly.edu

1) **Quantum Computer Programming.** This research will involve learning about quantum computer programming and simulators. The research will primarily utilize the open-source package Qiskit www.qiskit.org as well as others. The students will learn how to program a quantum computer and to develop a series of projects to be utilized for pedagogical purposes. **Student Background:** Physics and computer programming.

Professor James Lloyd, jlloyd@sunypoly.edu

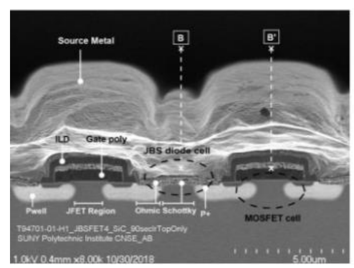
1) **Solar Wind.** The extraterrestrial environment is very different from what we experience on earth. (No kidding!) One environmental issue that is very different is that the solar wind, made up of particles ejected from the sun, is generally not a problem on earth due to the protection offered by our magnetic field and the atmosphere, but is significant in interplanetary space. Bombardment by energetic particles is a potential problem for the degradation of materials properties important in semiconductor devices. Of great interest and one that has not been studied is that of low-k dielectrics that have become common in contemporary electronic devices.

   Here on campus we can simulate solar wind with an accelerator in Prof. Bakhru's laboratory. Solar wind is composed mostly of protons accelerated to 0,5 to 10 keV. This can be simulated here. The program would be for the student to perform reliability tests (Time Dependent Dielectric Breakdown TDDB) on capacitors following exposure to energetic particles of varying energy and fluence. The student would perform these tests, analyze the data and compare the behavior, leading to a publication. **Student Background:** Mathematics, statistics and physics.

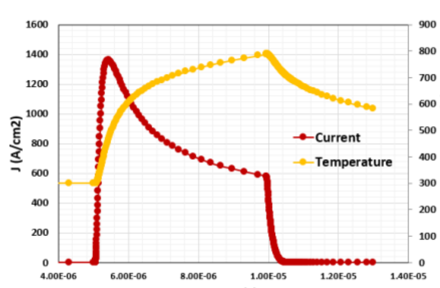
Unnikrishnan Sadasivan Pillai, usadasivanpillai@sunypoly.edu

1) **Impact of Artificial Intelligence on the Economy.** New techniques based on Artificial Intelligence is leading to automation of different types of work. While this increases productivity, it also leads to unemployment. This project will focus on assembling the industry level data and using it to perform some basic statistical analysis of the impact of AI on different sectors of the economy. **Student Background:** Any background (basic knowledge of statistics would be useful).

Professor Woongje Sung, wsung@sunypoly.edu



1) **Theoretical comparison between Planar and Trench type SiC MOSFETs:** A trench MOSFET is expected to provide a lower on-resistance in comparison with a planar MOSFET. However, in SiC, the corner of the trench not only degrades the breakdown voltage but also introduces a high electric field at the gate oxide. It is important to theoretically compare the performance of trench and planar MOSFETs. The student working on this project will conduct extensive 2-D device simulations. **Student Background:** Semiconductor device physics.
2) **Avalanche capability of SiC MOSFETs:** It is very important that a power MOSFET does not undergo a destructive failure while it is under an avalanche breakdown condition up to a sufficiently large current. In order to achieve high avalanche energy, a power MOSFET needs to be designed in such a way that the avalanche condition is initiated in the cell structure instead of the edge termination, periphery, or metal routers. The student will use 2-D device simulator, propose a novel idea, and test the avalanche capability.
   Student Background: Semiconductor device physics.



3) **Reliability of SiC MOSFETs:** The reliability assessment of SiC MOSFETs becomes more important as static performances are getting almost ideal. This project intends to 1) survey reliability tests for SiC MOSFETs, 2) study test conditions, 3) identify any difficulties in the reliability evaluations, 4) understand metrics and current status of SiC MOSFETs, 5) propose device designs or process schemes to improve reliability of SiC MOSFETs. **Student Background:** Semiconductor device physics.

Professor Susan Sharfstein, ssharfstein@sunypoly.edu

1) **Exploration of a bioengineered salivary gland** (joint with Yubing Xie). Loss of salivary gland function due to disease, surgery, radiation treatment or aging creates a host of health and quality of life issues. Current treatments are woefully insufficient with side effects that are often worse than original symptoms, creating an impetus to address this issue with regenerative medicine strategies. This project will employ on novel cryoelectrospun scaffolds to produce an engineered salivary gland that can be used to study salivary gland function and pathologies and potentially as an implantable device to restore salivary gland function. **Student Background: Chemical or biomedical engineering, chemistry or biology.**

Professor Yubing Xie, yxie@sunypoly.edu

1) **Design and Fabrication of Hydrogel Microstrands for 3D-Cell Culture.** In the body there exist tubular-shape tissues. In addition to mimicking these tubular tissue architecture, hydrogel microstrands provide a three-dimensional (3D) microenvironment for high density cell culture and aggregating self-assembly. This project will design and fabricate hydrogel microstrands and evaluate its suitability for primary cell expansion and stem cell differentiation, and tissue construction. It will provide a cost-effective and scalable hydrogel-based culture system for 3D cell culture, tissue engineering, and cell therapy. **Student Background:** Chemical or biomedical engineering, physics, chemistry or biology.