Descriptions of 2018 SURP Positions available on Albany Campus

Fifteen Professors and 30 Positions

Professor Ben Boivin bboivin@sunypoly.edu

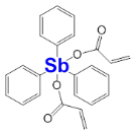
Will accept undergraduate researchers from SURP Programs A-C.

1) **Senescence of cardiac fibroblasts:** The Boivin research group studies the molecular mechanisms that control cell division in the heart. We have identified a novel molecular pathway that regulates division of fibroblasts and we are exploring how this novel signaling pathway is involved in fibrosis in aging and cardiovascular diseases. The student working on this project will work with a postdoctoral fellow and will learn a variety of state-of-the art approaches used in biochemical characterization of proteins. **Student background:** Biochemistry, chemistry or biology.
2) **Study a novel activator of the protein phosphatase PTP1B:** The Boivin research group has recently identified a novel activator of PTP1B. The student working on this project will work with a senior grad student and learn techniques of cellular biology and biochemistry in order to study the properties of this activator-peptide in cancer cells. **Student background:** Biochemistry, chemistry or biology.
3) **Study PTP1B regulation of cholesterol synthesis:** The Boivin research group has identified novel molecular links between the protein phosphatase PTP1B and cholesterol synthesis. The student working on this project will work with a senior grad student and learn techniques of computational biology, cellular biology and biochemistry in order to study how PTP1B is regulated and regulates cholesterol synthesis in cells. **Student background:** Biochemistry, chemistry or biology.

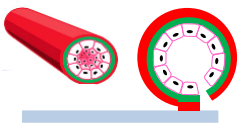
Professor Robert Brainard, RBrainard@SUNYPoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

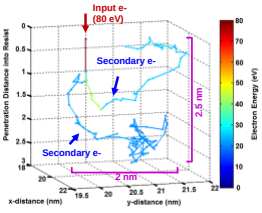
1) **Molecular Organometallic Resists for EUV (MORE).** Metal-based resists for use by the microelectronics industry to fabricate future integrated circuits. Students will synthesize and/or characterize compounds containing antimony, bismuth, tellurium or tin. These compounds are designed to undergo 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 small molecules and/or 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) **Modelling of Secondary Electrons from Extreme Ultraviolet (13.5 nm) light.** Members of our group have developed a Monte Carlo program that will model the interactions of high-energy electrons with matter. This project will also involve molecular modelling of the reactions of metal-based (MORE) resists while being exposed to high-energy photons. **Student Background:** Strong background in physics and computer modelling required. Rising sophomores welcome.



Professor Nathaniel Cady, ncady@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A or B.

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 Michael Carpenter, mcarpenter@SUNYPoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

1) **Plasmonics-Based Sensors.** Gold nanoparticles embedded in metal oxides have rich spectral properties which can be used in a variety of sensing applications including chemical, temperature and pressure sensors. Students will participate in deposition and characterization of these materials as well as test them for their viability as sensors. **Student Background:** No experience necessary, but background in chemistry, physics or other science/engineering fields is needed.

Professor James Castracane, jcastracane@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A.

1) **Engineering Functional Salivary Glands using Micropatterned Scaffolds.** In support of the overall program to re-create functioning salivary glands for patients who suffer from Xerostomia, this project involves the development of unique bioscaffolds created with electrospun nanofibers. By independently modulating nanotopography, micropatterning, and chemical signaling, the contributions of each factor will be optimized to identify specific parameters that support acinar cell differentiation and function. Scaffolds will be assessed for their ability to maintain differentiation or promote differentiation using a combination of acinar cell lines, ductal cell lines and primary cells. The intern will work with senior graduate students and will learn a variety of cell culturing protocols, electrospinning techniques, chemical functionalization of candidate nanofibers as well as operation of metrology tools including SEM and confocal fluorescence microscopy. The intern will participate in group meetings, present progress reports and prepare a final poster detailing his/her work. **Student Background:** Biology and Chemistry.
2) **Transitioning Breast Cancer Cell Motility Studies to Microgravity.** This project is focused on the development of the methods and materials for the study of cancer cell chemotaxis in a simulated microgravity environment. It will be based on the extension of ongoing research using the NANIVID, an implantable microdevice, which allows the attraction, imaging and capture of breast cancer cells in vivo. The intern will work with senior graduate students and will learn a variety of cell culturing protocols, electrospinning techniques, chemical functionalization of candidate nanofibers as well as operation of metrology tools including SEM and confocal fluorescence microscopy. The intern will participate in group meetings, present progress reports and prepare a final poster detailing his/her work. **Student Background:** Biology and Chemistry.

Professor Greg Denbeaux, gdenbeaux@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

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 Kathleen Dunn, kdunn1@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C

1) **Aging and oxidative effects in ceria CMP slurries.** Student will work with PhD candidate studying the impact of again, pH, and oxidizer concentration on material removal rates in chemical mechanical planarization. Will assist in data analysis of x-ray spectra and electron micrographs. **Student background**: inorganic chemistry, materials science, or physics; familiarity with Excel, Origin, ImageJ would beneficial but is not required.
2) **Novel metal processing for enhanced BEOL performance.** Student will analyze copper films subjected to a novel processing protocol for enhancing conductivity of nanoscale interconnects. **Student background:** semiconductors, metallurgy, materials science or engineering.
3) **Image analysis of EBID arrays.** Students will analyze nanoparticle arrays and pore distribution in support of ongoing efforts in electron beam induced deposition. Opportunity to develop automated analysis algorithms and assist in modeling growth process, depending on student interest/background. **Student background:** chemistry, materials science, physics or engineering; optional: mathematics or computer science.

Professor Michael Fasullo, MFasullo@SUNYPoly.edu

We will accept undergraduate researchers from SURP Programs A-B.

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. We identified novel genes that are involved in aflatoxin resistance that included DNA damage tolerance genes. This project will explore novel genetic mechanisms by which aflatoxin-associated DNA lesions are tolerated by error-free by-pass mechanisms. The project will involve yeast genetics to determine resistance pathways. **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 the liver cancer carcinogen, aflatoxin B1, and the colon-associated carcinogen, heterocyclic aromatic amines. 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.

Professor Spyros Galis, sgalis@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

1) **Development of silicon carbide nanodevices based on ultrathin self-aligned nanowire arrays**. We will investigate how synthesis and integration methods, fundamental factors (e.g., nanostructure, defect density), and operating regimes affect the electrical transport properties of ultrathin silicon carbide (SiC) nanowires (NWs). We will study innovative device designs based on these SiC nanostructured materials, as single or an ensemble of NWs can be driven electrically. **Student Background:** Physics, Electrical Engineering.
2) **Engineering rare-earth ion placement and emission through self-aligned photonic crystal nanostructures.** The SGNano research group is developing innovative Erbium (Er)-doped SiC nanostructured materials exhibiting unique optical properties at room temperature (e.g. high

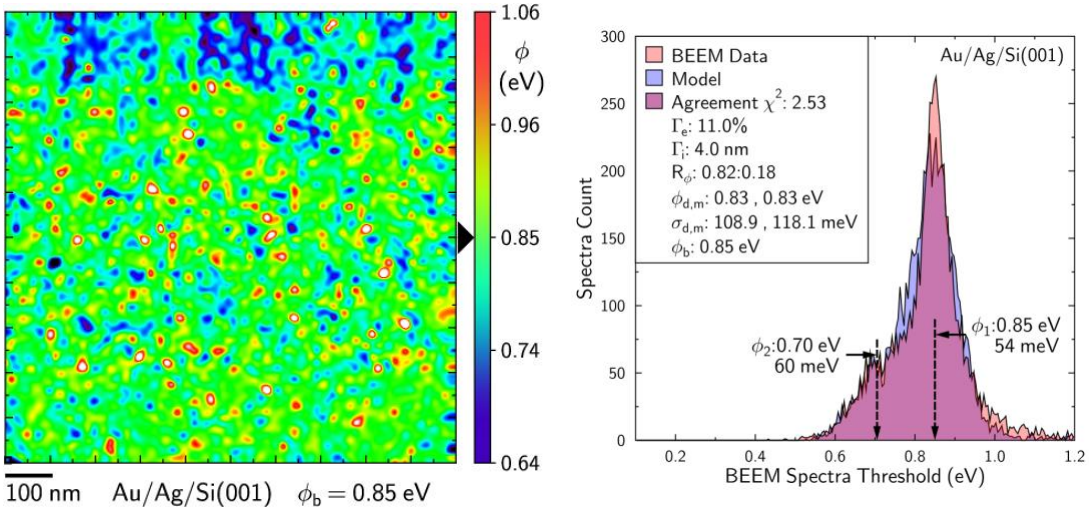
brightness, extraction efficiency and stability). We will employ theory and modeling to navigate experimental efforts. We will investigate the effects of synthesis, doping, and the dimensionality of the nanostructures on the optical properties, and emission modification, such as photoluminescence, extraction efficiency and spontaneous emission rate, of these new artificial photonic crystal materials. **Student Background:** Physics, Engineering.

3) **Study of emerging layered semiconductor materials and devices**. We will investigate the effects of oxidation on the Raman and photoluminescence properties of unpassivated and novel-passivated layered gallium telluride (GaTe) flakes. Tasks will include identification of process parameters to achieve optimum performance for the passivation layers, analysis of the compositional and structural properties of the passivation layers, and characterization of the resulting impact on the optoelectronic properties of the passivated GaTe systems. **Student Background:** Physics, Materials Science and Engineering, Electrical Engineering.

Professor Vincent LaBella vlabella@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

1) **Computational Modeling of Hot Electron Scattering for Nanoscale Schottky Barrier Visualization.** Electrostatic barriers at material interfaces are the foundation of electronic and optoelectronic devices. Their nanoscale uniformity is of paramount concern with the continued scaling of devices into the sub 10 nm length scale and the development of futuristic nanoscale devices. The electrostatic barrier at metal-semiconductor and metal-insulator-semiconductor interfaces can be visualized using a scanning tunneling microscope in a mode called ballistic electron emission microscopy (BEEM). The BEEM method measures the fraction of the tip current that makes it from the metal into the semiconductor as a function of tip bias and position. The local barrier height is measured by acquiring tens of thousands of BEEM spectra on a grid of tip positions and then fitting them to extract the threshold for onset of BEEM current, which is a measure of the minimum energy the carriers need to surmount the barrier. A false color image or map as well as histograms of these thresholds for a mixed Au/Ag/Si(001) sample are displayed in the figures.



Computational modeling has been developed to extract information about the interface composition and inelastic and elastic scattering rates from the measured histograms. The modeling for the mixed Au/Ag system indicates a mixture of two barrier heights from the individual metal species as well as a skewing to higher energy from the scattering of the hot electrons. Incomplete silicide formation as well as nanometer thick dielectric layers have also been studied and provides new insight into their effects on the electrostatics that is not possible with conventional bulk transport measurements. **Student Background:** Physics, and computer programming: Matlab, C/C++, Python, PHP, SQL. Knowing how to program for GPU boards (Nvidia CUDA) would be a plus but not required.

Jim Lloyd, jlloyd@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

1) **Determination of Diffusion Pathway in Copper Interconnect** My group is involved in the study of reliability issues in nano structured semiconductor devices. One of the most important failure mechanisms is electromigration, where metal atoms are "pushed" by conducting electrons leading to failure of the circuit. The traditional view is that grain boundary diffusion dominates, but the presently obtained values for the activation energy of the transport process does not support that. A straightforward experiment could be conducted where the dominant activation energy for failure would be determined as a function of temperature. For geometrical and kinetic reasons, there is a break in the Arrhenius plot from which the effective size of the transport pathway can be estimated and compared with expected values. The student would be performing the testing in our lab with samples already obtained in our lab. I would teach the student the physics behind the process and the student would be performing the analysis of the data him/herself. It is anticipated this work would lead to a publication. **Student Background:** Material Science would be best, but any interest in physics, chemistry or engineering would be beneficial. Biology students would be able to handle it, but probably wouldn't be interested.

Professor Juan "Andre" Melendez, jmelendez@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

Over 14,000 Americans die each year from kidney cancer with clear cell Renal Cell Carcinoma (ccRCC) being the most prevalent and malignant type. Disruptions in glutathione (GSH) metabolism have emerged as predictors of poor survival in ccRCC. Our studies indicate that defective epitranscriptomic regulation and impairment in selenocysteine (SEC) incorporation, resulting from deletion of the tRNA methytransferase Alkbh8 (*Alkbh8*$^{-/-}$), alters glutathione (GSH) metabolism and triggers a gene signature that is highly predictive (Hazard Ratio 2.65, $p < 0.0001$) of poor ccRCC survival.

1) **Senescence Quantification.** Quantitate markers of senescence and proliferative decline in Alkbh8 deficient mouse embryonic fibroblasts and human IMR-90 cells. **Student Background:** Biology or Chemistry.
2) **Survival Gene Signatures.** Study the importance of Alkbh8$^{-/-}$ ccRCC poor survival gene signature in renal cancer tumorigenesis. **Student Background:** Biology or Chemistry.
3) **Mitochondrial H_2O_2 Scavenging.** Fifteen percent of American adults (>30 million) suffer from some degree of chronic kidney disease (CKD). Medicare costs for patients aged 65 years or older with CKD were about $45 billion in 2012. Globally from 8-16% of the population worldwide is affected by CKD and in 2014 kidney disease was the 9th ranked cause of death nationally. Strategies to reduce burden and medical costs related to renal disease are critically needed. Senescence cells have recently emerged as contributors to age-related renal pathology. Strategies which limit the amplitude and duration of the senescence program will serve to delay age related renal decline. Student will determine if mitochondrial H_2O_2 scavenging can restrict senescence gene expression. **Student Background:** Biology

Professor Woongje Sung, WSung@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A.

1) **Electrical Performances of SiC MOSFETs.** Students will characterize the electrical performances of SiC MOSFETs/Diodes using a semiconductor analyzer and a probe station. **Student Background:** Basic understanding of semiconductor device physics and Microsoft Excel.

Professor Scott Tenenbaum, stenenbaum@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

1) **Structurally-Interacting RNA (sxRNA).** Alginate hydrogel is a biocompatible and FDA-approved materials for biomedical applications. The student working on this project will learn how to make alginate hydrogel microstrands and further optimize the process for controlled release of growth factors and/or 3D cell culture. **Student Background:** A basic understanding of molecular biology and genetics would be helpful.

Professor Yubing Xie, yxie@sunypoly.edu

Will accept undergraduate researchers from SURP Programs A-C.

1) **Microfluidic Synthesis of Hydrogel Microstrands.** Alginate hydrogel is a biocompatible and FDA-approved materials for biomedical applications. The student working on this project will learn how to make alginate hydrogel microstrands and further optimize the process for controlled release of growth factors and/or 3D cell culture. **Student Background:** Chemistry and/or biomaterials.
2) **Bioengineering Ocular Outflow Pathway for Understanding Glaucoma.** The capacity of creating ocular outflow pathway provides a new avenue to drug screening and testing pharmacological agents for glaucoma. The student working on this project will assist with mimicking and validation of the segmental outflow of the trabecular meshwork in vitro. **Student Background:** Chemical engineering and/or Biology.