1. Jason Schultz, Dr. Brian A. O'Brien

**Preparation of Fluorinated Phthaloylphosphine Derivatives and Primary Phosphines for Later Formation of Fluorinated Ionic Liquids**

Summer Advisor: Dr. Brian A. O'Brien  
Sponsor: American Chemical Society, Fluorine Division  
Home Institution: Gustavus Adolphus College  

**Abstract:**  
A straightforward method for the preparation an array of fluorinated organophosphorus compounds by P-alkylation and P-arylation of phthaloylphosphide ion is described. The procedure for using the resulting phthaloylphosphines for preparation of primary phosphines and fluorinated organic derivatives of hexafluorophosphate will be illustrated. This is done by a process of hydrazinolysis of the phthaloylphosphines, followed by the reaction of the primary phosphines with Selectfluor® to convert them to tetrafluorophosphoranes. Our goal is to use these tetrafluorophosphoranes to prepare organofluorine analogs of hexafluorophosphate ion by reaction with cesium fluoride.

2. Hasan Arslan, Elisey Yagodkin

**A Synthetic Route to Rubrene and Novel Rubrene Derivatives**

Summer Advisor: Christopher J. Douglas  
Sponsor: Department of Chemistry Lando/NSF  
Home Institution: Middle East Technical University, Turkey  

**Abstract:**  
Rubrene (5,6,11,12-tetraphenyltetracene) is an organic semiconductor with high hole mobility (μ = up to 20cm²/(V·s)) and therefore it is a potential alternative to silicon in electronic devices. In this project, it is aimed to develop a synthetic route for the synthesis of rubrene and rubrene derivatives with novel electronic properties. The method used for this purpose utilizes the Suzuki–Miyaura reaction of 5,6,11,12-tetrachlorotetracene with various organoboranes including triarylboroxines, trifluoroborate salts and organoboronic esters.

3. Logan Bodnia, Tony Borgerding

**Analysis of Atrazine using Solid Phase Extraction and LC–MS–MS**

Summer Advisor: Tony Borgerding  
Sponsor: Department of Chemistry  
Home Institution: University of St. Thomas  

**Abstract:**  
Atrazine is a common herbicide used commonly in commercial agricultural fields. Atrazine gets into lakes from runoff and causes environmental problems if it persists. Using Solid Phase Extraction I hope to concentrate solutions down so as to allow for detection from the LC–MS–MS. The LC–MS–MS allows for selectivity of the atrazine molecule eliminating most other interferences. Using SPE and LC–MS–MS the goal of this project is to be able to quantify amounts of atrazine in shallow lakes.

4. Kellen Chamblee

**Qualitative and Quantitative Analysis of a Bio-fuel Gas Sample**

Summer Advisor: Ron Fedie  
Sponsor: Department of Chemistry  
Home Institution: Augsburg College  

**Abstract:**  
Qualitative and quantitative analysis of gaseous vapors produced by the McGyan process (mol% and mass%). Gaseous vapor mixture contained unknown gases at unknown amounts, purpose of research was to calculate both.
5. Rita Cook, Kristen A. Thoreson, Kristopher McNeill

**Dechlorination of Trichloroethylene (TCE) using Zero-Valent Iron in Organic Solvents**

**Summer Advisor:** Kristopher McNeill  
**Sponsor:** Chemistry Lando/NSF  
**Home Institution:** Ohio Wesleyan University  

**Abstract:**
Zero-valent iron (ZVI) is currently employed to remediate groundwater contaminated with TCE, however the mechanism of the dechlorination reaction is not well understood. In order to compare the mechanism of ZVI-mediated dechlorination to that of a well-characterized phosphino-iron(0) model complex, dechlorination of TCE with ZVI was studied in organic solvents. The reaction was carried out with 100 mesh iron(0) in oxygen and water-free conditions using THF and toluene as solvents. TCE loss was monitored by GC/MS. The reaction in water-free THF resulted in complete degradation of TCE after several days, but only a 10% decrease in TCE concentration was observed in water-free toluene over the same timescale. The dechlorination reaction in water-free toluene with tert-butanol as a proton source was also evaluated.

6. Natalie Crooks

**Synthesis of Fluorescent Probes for Uptake Analysis in S. Cerevisiae**

**Summer Advisor:** Dr. Rita Majerle, Dr. Jodi Goldberg  
**Sponsor:** Department of Chemistry  
**Home Institution:** Hamline University  

**Abstract:**
The goal of this project is to synthesize a fluorescent probe to be used in the analysis of the uptake of carbohydrates by S. Cerevisiae. Using protocols from previous research, we have experimented to determine the best way to synthesize and purify the product, 2-[N-(7-nitrobenz-2-oxa-1,3-diazol-4-yl) amino]-2-deoxy-D-glucose. This probe was synthesized using D-glucosamine and NBD-Cl. Products were analyzed using TLC, liquid chromatography, and UV fluorescence. Purification is still a problem, and we are in the process of exploring new solvent systems to make the reaction cleaner. Carbohydrate uptake in yeast cells was determined using a flow cytometer. Future goals are to alter the product by acetylation to obtain good NMR data, synthesize other fluorescent probes, and adjust the protocol to be used in an undergraduate lab.

7. Patrick Fahey, Erik Goebel, Andy Harned

**Efforts Towards the Total Synthesis of Anthecularin: A Sesquiterpene Lactone Exhibiting Antimalarial Activity**

**Summer Advisor:** Andy Harned  
**Sponsor:** Department of Chemistry  
**Home Institution:** Washington University in St. Louis  

**Abstract:**
Allenes are utilized for their ability to participate in a wide variety of organic reactions including nucleophilic additions, electrophilic additions and cycloadditions, and as such are widely recognized as useful substrates en route to synthesis of larger molecules. However, there are few examples within the literature where an enantioenriched allene has been used to set stereocenters in a larger molecule. Enantioenriched allenes have been created using a ruthenium-catalyzed reduction of a substituted ynone, followed by mesylation of the resulting alcohol and a palladium-catalyzed carbonylation under high pressure. This allene was then used in a cycloaddition to set four stereocenters in an intermediate molecule en route to the total synthesis of anthecularin.
8. Jaclyn Fermanich, Tyler J. Smith, Dr. William H. Ojala

*Intermolecular Interactions in Crystalline Benzylideneanilines: Packing Motifs Differentiating Some Fluoro/Cyano and Bromo/Cyano Derivatives*

Summer Advisor: Dr. William H. Ojala (University of St. Thomas)
Sponsor: Department of Chemistry, University of St. Thomas
Home Institution: University of St. Thomas

**Abstract:**
We use single-crystal X-ray diffraction to examine molecules we designate as "bridge-flipped isomers," molecules differing only in the orientation of a bridge of atoms connecting two major molecular fragments. Among the benzylideneanilines, this isomerism is Ar-CH=N-Ar' vs. Ar-N=CH-Ar', where Ar = aryl. Different isomers assuming the same solid-state packing arrangement might readily co-crystallize to form new materials, so we examine intermolecular interactions that might occur in both crystalline isomers and favor this isostructuralism. Here we describe the crystal structures of two bridge-flipped isomeric benzylideneaniline pairs in which halogen-nitrile, hydrogen-nitrile, or halogen-halogen contacts might define the packing arrangement. In both cases, we find that the isomers are not isostructural and are differentiated from each other by packing motifs occurring in only one isomer of each pair.

9. Craig Foster

*MutS Mismatch-Binding Protein as a Tool for Enhancing Detection of Mitochondrial DNA Mutations*

Summer Advisor: Edgar Arriaga
Sponsor: Department of Chemistry
Home Institution: University of Minnesota–Twin Cities

**Abstract:**
Mitochondria have their own genome which is independent of the nuclear genome of the cell. Because there are multiple mitochondria in a cell, mutated mitochondrial DNA (mtDNA) can exist alongside the original mtDNA of the cell. Standard DNA sequencing techniques cannot detect mtDNA mutations that occur at low levels within a cell, and to address this issue, I have attempted two different techniques to separate mutated DNA using MutS, a mismatch–binding protein. The first technique involved capillary electrophoresis to separate mismatches created from mutated DNA based on the different affinity of MutS for different mismatches, but has remained unsuccessful to date. The second, ongoing technique is the use of polyhistidine-tagged MutS to capture mismatched DNA in an affinity chromatography column.

10. Anthony Gerten, Dr. William Ojala

*Toward Isostructural Isomeric Benzylideneanilines: A Severely Nonplanar Conformation Forced by 2,6-Disubstitution*

Summer Advisor: Dr. William Ojala
Sponsor: Department of Chemistry, University of St. Thomas
Home Institution: University of St. Thomas

**Abstract:**
Molecules we designate "bridge-flipped isomers" differ only in the orientation of a bridge of atoms connecting two major molecular fragments. Among the benzylideneanilines, this isomerism is Ar-CH=N-Ar' vs. Ar-N=CH-Ar', where Ar = aryl. Isostructural (same solid-state molecular packing) isomers might be readily co-crystallized to form new materials, so we are using single-crystal X-ray diffraction to identify such pairs. Conformational differences will cause isomeric benzylideneanilines to assume different packing arrangements, so previously we identified planar benzylideneanilines in the literature and examined their isomers in the hope that both isomers would be planar, yielding isostructural crystals. We propose here a new strategy: forcing both isomers to assume a severely nonplanar conformation by 2,6-disubstitution on the rings. This conformation exists in the benzylideneaniline obtained from 2,6-dimethylaniline described here.
11. Mary Hammer  
*ESI High Resolution MS Analysis of Common Commercial Products*  
Summer Advisor: Dr. Borgerding  
Sponsor: Department of Chemistry  
Home Institution: University of St. Thomas  
**Abstract:**  
Common Commercial Products have been analyzed on a QTOF mass spectrometer to discover the content and fragment peaks of the various compounds found in these products. Perfluorinated compounds (PFCs) were extracted from Scotchguard and Crest Glide dental floss to a concentration around 10ppm and were analyzed using MS and MS/MS. The Scotchguard peaks show the C8 (m/z=498.9012), C6 (m/z=398.8983), and C4 (m/z=298.9321) sulfonates. Crest Glide was shown to have the C6 acid (312.9723). Mercaptopropane Sulfonic Acid (MPS) was analyzed using MS/MS and fragments peaks were found at 186.9789, 208.9575, 152.9832, 121.0169, and 176.9895. One uM Triclosan was analyzed using MS and a peak was found at 286.9438. Surfactants and optical brighteners were analyzed from Tide laundry detergent and MS/MS analysis was performed on the largest peaks.

12. Nicholas A. Hefty  
*Synthesis of a Ring–Substituted Derivative of the Anticonvulsant Drug Phenytoin*  
Summer Advisor: Brian A. O'Brien, Todd A. Swanson  
Sponsor: Department of Chemistry  
Home Institution: Gustavus Adolphus College  
**Abstract:**  
Phenytoin (diphenylhydantoin) is an anticonvulsant drug widely used in the treatment of Parkinson's Disease and other medical conditions, and so an understanding of the molecular mechanism of action of phenytoin is highly desirable. One approach to this problem is to attempt to isolate a phenytoin–binding receptor. Here we describe our progress on the synthesis of a phenytoin derivative that bears a tethering chain capped by a primary amino group for binding to an affinity gel. The sequence begins with a Mitsunobu reaction of an N-protected aminoalcohol with p-iodophenol; the remainder of the sequence consists of Sonogashira coupling of the resulting iodo derivative to phenylacetylene, conversion of the alkyne to a benzil, and reaction of the benzil under basic conditions to form the substituted phenytoin.

13. Seth Huiras, Sean Dawson and Janice Pellino  
*Researching the Structures and Roles of Non–coding Small RNA Strands from Escherichia coli*  
Summer Advisor: Janice Pellino  
Sponsor: Department of Chemistry  
Home Institution: St. Olaf College  
**Abstract:**  
Non–coding small RNAs (sRNA) are thought to be important in regulating gene expression in prokaryotes, but only a handful have been extensively researched. Choosing two sRNAs from the K–12 strain of E. coli, we performed mercury–acylamide gel shift assays, RNase H protection assays, biotin pull downs, and western blots in order to determine the tertiary structure of our sRNAs and identify any associated protein complexes. We believe that the products of the RNase H protection assays and the mercury–acylamide gel shift assays were under the visualization limits of the Sybr Gold© staining technique. The biotin pull down assays resulted in a unique protein interaction with protein(s) (~80kDa) for both of our sRNAs.
14. **Melissa Joyce**, Dr. Joseph Brom  
**A Computational Study of TiH$^{5+}$ and CH$^{5+}$**  
Summer Advisor: Dr. Joseph Brom  
Sponsor: Department of Chemistry  
Home Institution: University of St. Thomas  
**Abstract:**  
Interest in three-center-two electron bonds leads to a study of CH$^{5+}$ and TiH$^{5+}$. The electronic structure of CH$^{5+}$ and TiH$^{5+}$ was examined using GAMESS (General Atomic Molecular Electronic Structure System). MCSCF (Multiconfiguration Self Consistent Field) calculations with basis sets of 6–311G(d) for CH$^{5+}$ and a triple zeta basis set with polarization and diffuse functions for TiH$^{5+}$ have been completed. For both molecules, the CS point group leads to a structure where the H$_2$ moiety can either be perpendicular to or parallel to the mirror plane. One of these conformations is a transition state structure and the other one is a minimum on the potential energy surface. The CH$^{5+}$ molecule exhibits three-center-two-electron bonding while this particular type of bonding is not seen in the TiH$^{5+}$ species.

15. **Andrew R. Knoff**, Dan A. Everson  
**A Clickable Vitamin D Derivative**  
Summer Advisor: J.T. Ippoliti  
Sponsor: Department of Chemistry, University of St. Thomas  
Home Institution: University of St. Thomas  
**Abstract:**  
Vitamin D3 is an important biomolecule for maintaining homeostasis in the human body. A method for quantifying Vitamin D concentration in the blood is currently an area of active research. In order to attack this problem of quantification, we have effectively attached an acyl functional group with a terminal alkyne creating a "clickable" vitamin D3 moiety. We have successfully synthesized an anhydride containing a terminal alkyne and by utilizing Fu’s catalyst we have selectively added the anhydride to 25-hydroxycholecalciferol’s (Vitamin D3) secondary alcohol in the presence of a tertiary alcohol. The terminal alkyne group can participate in “click” reactions with enzymes containing an azide functional group to give triazoles and the Vitamin D3 derivative can be quantified using enzyme-linked immunosorbent assay (ELISA).

16. **Andrew Korte**  
**Environmental Photochemistry and Photoproducts of Three Fluoroquinolone Antibiotics**  
Summer Advisor: Dr. Kristine Wammer (University of St. Thomas)  
Sponsor: Department of Chemistry, University of St. Thomas  
Home Institution: University of St. Thomas  
**Abstract:**  
The fate of three fluoroquinolone antibiotics (norfloxacin, ofloxacin, and enrofloxacin) were examined under environmentally–relevant conditions. Photodegradation has been previously shown to be a major environmental path for these compounds, with degradation rate being significantly affected by water pH. For this reason, photodegradation quantum yields were calculated for three protonation species of each compound based upon experimentally derived pKa, absorption, and degradation rate data. For all three drugs, quantum yields were found to be highest for the species predominant in most natural waters, moderately lower for the anionic form, and nearly zero for the cationic form. Additionally, structures were proposed for several norfloxacin and enrofloxacin photoproducts based upon LC–MS and high–resolution MS data. Future work will focus on isolation and identification of biologically active enrofloxacin photoproducts.
17. **Jeremy Leavell**, Dr. William H. Ojala  
*Structure–Defining Interactions Involving the Nitro Group in Crystalline “Bridge–Flipped” Isomeric Phenylhydrazones*  
Summer Advisor: Dr. William H. Ojala  
Sponsor: Department of Chemistry, University of St. Thomas  
Home Institution: University of St. Thomas  
**Abstract:**  
We designate as "bridge–flipped isomers" molecules that differ only in the orientation of a bridge of atoms connecting two major molecular fragments. Among phenylhydrazones, this isomerism is Ar–NH=N=CH–Ar' vs. Ar–CH=N-NH–Ar' where Ar = aryl. Because isostructural isomers (those having identical crystal structures) might readily co-crystallize to form new materials, we use single–crystal X-ray diffraction to identify isostructural pairs. Similar intermolecular interactions in different isomers might encourage isostructuralism, so we examine packing motifs common in phenylhydrazones. In the 4-nitrobenzaldehyde-4’–chlorophenylhydrazone structure described here, one nitro group oxygen atom contacts both the C–H and N–H hydrogen atoms of a neighboring bridge. If no significant H–bonding distinction exists between those hydrogen atoms, bridge reversal may leave the crystal structure unaffected and allow formation of an isostructural bridge–flipped isomer.

18. **Kellen Miller**  
*Thermal- and Photo-induced SiO₂ Coating of Silver Nanoparticles*  
Summer Advisor: Adam Boies, Dr. Jeff Roberts  
Sponsor: Department of Chemistry, University of Minnesota, Lando/NSF Research Fellowship  
Home Institution: Santa Rosa Junior College  
**Abstract:**  
For nanoparticles to be useful in a wide variety of applications, methods must be developed to control their surface properties. We show here that silver nanoparticles can be coated with silica (SiO₂) using a combined thermal– and photo-assisted chemical vapor deposition (CVD) process. Streams of silver nanoparticles, generated by evaporation, were mixed with gaseous tetraethoxysilane [(C₂H₅O)₄Si, TEOS] in an atmospheric pressure aerosol flow tube reactor. The particle / TEOS / carrier gas mixtures were passed through a heated tube reactor and simultaneously exposed to vacuum ultraviolet radiation from an excimer lamp. Particle samples were collected and subjected to compositional and morphological analysis by Fourier transform infrared spectroscopy (FTIR) and transmission electron microscopy (TEM), respectively. Results establish that Ag nanoparticles were coated with nanoscale SiO₂ layers.

19. **William Montes**, Dr. Thomas C. Marsh  
*Printing Non-Polar Polymers Using the Bioforce Nano eNabler™ Open Channel Micro–patternning Tool*  
Summer Advisor: Dr. Thomas C. Marsh  
Sponsor: Department of Chemistry  
Home Institution: University of St. Thomas  
**Abstract:**  
The Nano eNabler™ (NeN) is a versatile micro/nano–scale printing tool for creating arrays of materials with high precision and accuracy. An open channel microfluidic device is used to deliver very small volumes of solution to a surface. The majority of current applications for the NeN are focused on creating patterns of water–soluble polymers, biomolecules, viral particles and living cells on various surfaces. In order to use the NeN for creating arrays of non–polar molecules, a suitable solvent with low vapor pressure is required. This work describes the development of a sample preparation method and instrument parameters that enable printing arrays of polystyrene (PS) and polymethylmethacrylate (PMMA) onto substrates such as SiO₂, Au, Mica and Indium Tin Oxide.
20. Andrew Rischall, Tony Borgerding
*Increasing Sensitivity of Gas Phase Microdialysis Probes Using a Carbon Nanotube Coated Column*

**Sponsor:** Department of Chemistry  
**Home Institution:** University of St. Thomas  
**Abstract:**  
Gas phase micro-dialysis extraction (GPME) probes are used to extract volatile organic compounds (VOCs) from aqueous solutions. Current GPME probe research has been successful in monitoring reactions and analyzing analytes in diverse environments with an FID. A major constraint while using GPME probes is their lack of sensitivity to small concentrations of analytes (~1–20mM). Sensitivity of GPME has been increased by cryofocusing analytes with a carbon nanotube (CNT) coated column. Analyte is rapidly desorbed off the column by using a Nichrome wire and resistive heating. The CNT coated column is able to trap ethanol at 40 °C and toluene at temperatures above 60 °C. Solutions of 100 nM ethanol and 10 nM toluene have been detected with GPME probes during 10 second cryofocusing periods.

21. Matthew Slattery
*Analysis of The Antibacterial Activity of Tetracycline And Its Photoproducts*

**Summer Advisor:** Dr. Kristine Wammer  
**Sponsor:** Department of Chemistry, University of St. Thomas  
**Home Institution:** University of St. Thomas  
**Abstract:**  
Tetracycline is commonly used in veterinary therapy, culture ponds, and as a human antibiotic and trace amounts of tetracycline have been detected in the environment. In this study the photodegradation of tetracycline, under environmentally-relevant conditions, was examined to determine the fate and behavior of its photoproducts. Tetracycline, by direct photolysis, is known, in varying conditions, to degrade into 7 different photoproducts. Water hardness and pH are two characteristics of a natural environment that can alter the decomposition pathway of tetracycline. Here, the growth of the bacterial strain E. coli. DH5a was measured by UV vis spectrophotometry (600 nm) in the presence of varied concentrations of both photolyzed and unphotolyzed tetracycline to determine the potential antibacterial activity of its photoproducts in diverse waters and conditions.

22. Jennifer Soltis, Jasmine Erbs
*Effects of Additives on Ferrihydrite Growth and Phase Transformation*

**Summer Advisor:** R. Lee Penn  
**Sponsor:** Department of Chemistry, Lando/REU  
**Home Institution:** Mount Holyoke College  
**Abstract:**  
Goethite (alpha-FeOOH) is a crystalline iron oxide nanorod often synthesized by precipitation from homogeneous solution of ferrihydrite (Fe₅H₄O₈•4H₂O) nanoparticles following by aging. This poster addresses the growth of goethite nanorods by phase transformation of ferrihydrite nanoparticles followed by oriented aggregation (OA) in the presence of four additives: (PO₄³⁻, Fe(II), alizarin, sucrose; 0.01–10 mM concentrations.) Particle size and size distributions were quantified using calibrated transmission electron micrographs and dynamic light scattering. For experiments employing PO₄³⁻, Fe(II), and sucrose, the dominant growth mechanism was OA, all at slower growth rates than untreated ferrihydrite. Experiments employing alizarin, a catechol, resulted in dramatically suppressed growth by OA but accelerated growth of the primary nanoparticles by coarsening, which is significant because it permits particle growth beyond the originally synthesized size.
23. **Amanda Stemig**  
*Antibacterial Activity of Oxytetracycline and Its Photoproducts*  
Summer Advisor: Dr. Kristine Wammer  
Sponsor: Department of Chemistry, University of St. Thomas  
Home Institution: University of St. Thomas  
**Abstract:**  
Oxytetracycline, a derivative of tetracycline, is an antibiotic commonly used to treat both humans and animals and has been detected in natural water systems. It is known that oxytetracycline, along with other tetracycline derivatives, photodegrades when exposed to sunlight and recent concerns have emerged that some of its photoproducts may also retain antibacterial activity. The antibacterial activity of oxytetracycline and its photoproducts were studied under various natural water conditions to determine if the photoproducts indeed introduced more antibacterial activity. Oxytetracycline degrades to very low concentrations at a fairly rapid rate in each of the natural water samples. The photoproducts of oxytetracycline do not retain significant antibacterial activity, even though different photoproducts are made under different water conditions such as pH and metal ion concentrations.

24. **Sarah S. Sullivan**, Daron E. Janzen  
*Organometallic Platinum Complexes for Use as Electronic Materials*  
Summer Advisor: Kent R. Mann  
Sponsor: Chemistry, Lando Program  
Home Institution: College of St. Catherine  
**Abstract:**  
New molecular electronic materials with tailor-made electronic, chemical, and structural properties are of interest due to potential advantages they have over silicon-based semiconductor materials. The objective of this project is to make a new series of molecular electronic materials that have enhanced properties for use in LECs (light-emitting electrochemical cells). A series of organometallic square planar platinum (II) complexes of the form [Pt(bq)(CNR 2BF 4 (bq = 7,8-benzoquinolate, R = i-Pr, Xylyl, p-C 6H 4 -C 2H 5) have been prepared from the new complex [Pt(bq)(CH 3CN) 2BF 4, a useful synthon for these isocyanide complexes. All of these complexes were fully characterized by mass spectroscopy, ATR-IR, NMR, and solid-state absorption. Of particular interest, all of these complexes exhibit solid-state emission that is dramatically shifted (556–673 nm) by the choice of ligands (CH 3CN or RNC).

25. **Bradley Towey**, Dr. Tom Anderson  
*Mixing of Dissimilar Lipids in Membranes*  
Summer Advisor: Dr. Tom Anderson  
Sponsor: Department of Chemistry  
Home Institution: Hamline University  
**Abstract:**  
Non-ideal mixing between two different phospholipid membranes was characterized by measurement of the heat of mixing. The mixing process was studied for the phospholipids POPC and POPG, which have identical hydrocarbon tails but differ in their polar head groups. For a 1:1 mixture, the experimentally determined heat of mixing of POPC and POPG was −150 J/mol. Also, a mathematical model generated similar results for the titration of phospholipids into cyclodextrin, which was done in previous research. An equilibrium constant of 1.86*10^{-6} was derived from the mathematical model for a phospholipid molecule binding to cyclodextrin. Investigating the measured heats of mixing of POPC and POPG can potentially lead to understanding of other areas of phospholipid research.
26. **Ryan Espy**  
*Photolytic and Hydrolytic Degradation of Imazethapyr*  
Summer Advisor: Amanda Nienow  
Sponsor: Gover Fund  
Home Institution: Gustavus Adolphus College  
**Abstract:**  
Imazethapyr is a relatively new agrochemical used to prevent weeds in soybeans, beans, and alfalfa. Since imazethapyr has been detected in over 50% of Midwestern U.S. water samples, we are interested in determining pathways of photolytic abiotic degradation. We have observed photolysis of imazethapyr in deionized water (direct) and Minnesota River water (indirect). Imazethapyr degraded in both laboratory and natural UV-light sources. Indirect photolysis was slower than direct photolysis. Additional experiments with natural organic matter (NOM) in deionized water show that high NOM concentrations decrease the rate constant. Thus, the slow, indirect photolysis rate constants are attributed to light filtering caused by NOM in the river water. Currently, we are working to elucidate the photolytic degradation pathways and are also examining the hydrolysis of imazethapyr.

27. **Christina Cowman**, Sayeed Abbas  
*A Study of the Conditions for Macrophase Separation in Diblock–copolymer Systems with Dilute Homopolymer Concentrations*  
Summer Advisor: Timothy P. Lodge  
Sponsor: Heisig–Gleysteen Research Fellowship  
Home Institution: University of Minnesota – Twin Cities  
**Abstract:**  
The conditions under which macrophase separation occurs can be explored by examining systems that phase separate at relatively high temperatures. The polymer system SI(16–16)30% in diethyl phthalate and the addition of polystyrene (180 kD) resulted in macrophase separation at high temperatures. This behavior is counterintuitive since most solvents become less selective at high temperatures. This phenomenon is entropic in nature and is rarely observed in organic solvents. Characterization methods such as small–angle X-ray scattering, dynamic light scattering, and optical microscopy are being used to examine the size ratio of diblock–copolymer micelles to homopolymer size, temperature, and concentration. This data can be used to identify critical conditions of phase separation and explain why many similar systems phase separate at lower temperatures or do not phase separate at all.

28. **Chad Larson**, Michael Wentzel  
*Exploration into Substrate and Co–Catalyst Directed Carbon–Carbon Sigma Bond Activation*  
Summer Advisor: Christopher Douglas  
Sponsor: Heisig/Gleysteen  
Home Institution: University of Minnesota – Twin Cities  
**Abstract:**  
Carbon–carbon sigma bond activation is a relatively unexplored reaction pathway that has the potential to give structurally complex products and lead to efficient syntheses of desirable compounds, such as pharmaceuticals and plastics. To date, three substrates have been synthesized for carbon–carbon sigma bond activation studies. For reaction selectivity it is necessary to have a directing group, which is directly incorporated into one substrate while the other two substrates utilize it as a co–catalyst. These specific substrates have given insight into particular aspects of the proposed reactivity.
29. **Jon Rotzenberg**, Adam Huss, Francesc Molins  
**Excitation Migration in Conjugated Polymers**  
Summer Advisor: David A. Blank  
Sponsor: Heisig/Gleysteen Chemistry Summer Research Program  
Home Institution: University of Minnesota – Twin Cities  
**Abstract:**  
The Blank Group at the University of Minnesota examines the energy dynamics of organic semiconducting polymers in order to gain the type of basic understanding that may help us discover a more economical material to be used in solar cells. This particular project investigates how the crystalline structure of poly(3-hexylthiophene) effects its electronic properties. The ultimate goal of the project is to determine the influence of polymer film morphology on energy migration in poly(3-hexylthiophene), a leader among organic semiconducting polymers.

30. **Jon Athmann**, Jun Sung Kang  
**Synthesis of Multivalent Polymers for Biocompatible Micro and Nano Surfaces**  
Summer Advisor: T. Andrew Taton  
Sponsor: Lando Program, University of Minnesota  
Home Institution: University of St. Thomas  
**Abstract:**  
To exceed the bonding capabilities of mono-thiol ligands to gold nanoparticles, several multivalent thiols were prepared. It is presumed that the multiple bonding sites will provide a higher overall stability of the particle when compared to mono analogues. This research involves grafting poly(ethylene glycol) to a poly(L-lysine) backbone to increase biocompatibility and provide feasible functionality. Thiols were also incorporated into the polymer backbone to provide multiple bonding sites to the gold nanoparticle surface.

31. **Sunil Baidar**, Beau Barker  
**Negative Ion Photoelectron Spectroscopic Study of Mo\(^2\)**  
Summer Advisor: Doreen Leopold  
Sponsor: Lando/NSF and Chemistry Department  
Home Institution: Dickinson College, Carlisle, PA  
**Abstract:**  
The homonuclear diatomic metal ion Mo\(^2\) was studied using negative ion photoelectron spectroscopy. This bare, homonuclear group 6 transition metal dimer allows the study of multiple metal–metal bonding free of ligand effects. The photoelectron spectra, obtained at 488 nm with an instrumental resolution of about 6 meV (50 cm\(^{-1}\)), provide measurements of the electron affinities, vibrational frequencies for both the anion and the neutral states, and bond length changes upon electron detachment. The Mo\(^2\)\(^-\) spectra displays a transition to the multiply-bonded \(1\Sigma_g^+(d\pi)^4(d\delta)^4(d\sigma)^2(s\sigma)^2\) ground state of the neutral molecule. In the anion, the extra electron occupies the vacant antibonding s\(\sigma^*\) orbital, giving a \(2\Sigma_u^+\) ground state. Density functional theory calculations of the anion and neutral species were performed to help elucidate the spectroscopic assignments.
32. **Kyle Denk**, Won Cheol Yoo  
**Nanoselective Membranes using 3-Dimensionally Ordered Macroporous (3DOM) Carbon**  
Summer Advisor: Professor Andreas Stein  
Sponsor: Lando-NSF  
Home Institution: Truman State University  
**Abstract:**  
Separation of sub–micrometer sized particles has important industrial applications such as separating bacteria from milk and yeast from beer. Three Dimensionally Ordered Macroporous (3DOM) materials, the inverse structure of face centered cubic (fcc) packed colloidal crystals, are a good candidate for membranes. 3DOM materials are interlinked by windows that form where the colloids used to template the macropores contact each other. Thus, throughout the membrane, each pore (empty space where the colloidal sphere was), has 12 different windows connecting it to another pore. Due to this, 3DOM materials exhibit a high surface area to volume ratio and offer simple pore and window size tunability, by controlling the size of the templating colloids. For a membrane, 3DOM carbon is an ideal material due to its chemical and physical stability. This study investigates 3DOM carbon whose selectivity is on the nanoscale (20 – 200 nm), depending on its window size.

33. **Laura Granda**, Paul Boswell, Melissa Fierke, Chun–ze Lai, Andreas Stein  
**Use of Ion–Selective Electrodes with 3DOM Carbon Contacts for the Detection of Perfluoroalkyl acids**  
Summer Advisor: Philippe Buhlmann  
Sponsor: Lando/NSF  
Home Institution: University of Puerto Rico at Mayaguez  
**Abstract:**  
Perfluoroalkyl acids (PFAAs) represent a noteworthy environmental problem. Recent reports shows that these compounds are distributed world–wide, they do not degrade easily and are bio–accumulative. Therefore earlier efforts have been conducted to detect these compounds with flouorous membrane ion selective electrodes (ISEs), which were found to exhibit very high selectivity. In this work, three–dimensionally ordered macroporous (3DOM) carbon was used as the solid contact for PFAA ISEs. 3DOM carbon infused with a polymeric membrane provides very stable potentials and low detection limits for others analytes. This work has shown that 3DOM carbon contacts combined with flouorous liquid sensing membranes supported with polytetrafluoroethylene filter disks (PTFE) can give a 7.8x10^{-7} M detection limit. Work to further improve the detection limit by using polymer additives are in progress.

34. **Adriann Hovey**, Joe Katzenmeyer  
**Preliminary Development of Quantitative Immunoassays for Mitochondrial Proteins**  
Summer Advisor: Dr. Edgar Arriaga  
Sponsor: Lando/NSF  
Home Institution: University of Northern Iowa  
**Abstract:**  
Mitochondria are involved in various diseases and aging. Specific measurement of mitochondrial proteins could help determine their role in these processes. An antibody against cytochrome oxidase labeled with Alexa Fluor 488 was chosen to develop a general immunoassay for the quantitation of mitochondrial proteins using capillary electrophoresis with laser induced fluorescence detection. Analysis of the antibody with capillary electrophoresis produced broad peaks and irreproducible results due to heterogeneity and interactions with the capillary walls and coatings. The best peak profile was obtained with no capillary coating. The antibody peak profile appeared to have changed after incubation, which suggests the presence of cytochrome oxidase in the mitochondrial protein sample. More tests need to be done to obtain quantitative results and a higher resolution of peaks.
35. Natalya Khanina  
**A Comparison of the Efficiencies of HPLC Columns Packed with Fully Porous and with Superficially Porous Particles**  
Summer Advisor: Peter W. Carr  
Sponsor: Lando  
Home Institution: Carnegie Mellon University  
**Abstract:**  
Superficially porous particles are used to improve HPLC efficiency at high velocity. They are made by surrounding a non-porous, solid core with a thin layer of porous silica. In order to better understand such particles, we have evaluated their internal diffusion characteristics by measurements of diffusion coefficients using the “arrested elution” method. We have shown that equations that are widely used in the study of diffusion in free solution, such as the Wilke-Chang and the Chen-Horvath equations, are not very accurate. Ultimately we will compare the diffusion coefficients of superficially porous and fully porous HPLC particles and then extend the work to understanding the contribution of internal resistance to mass transfer to efficiency in HPLC.

36. Terese Kreifels, Adam Wohl  
**Studies on the Role of Acetylenedicarboxylic Acid (and Trifluoroacetic Acid) in the Polymerization of μ-Caprolactone**  
Summer Advisor: Thomas R. Hoye  
Sponsor: Lando/NSF, Chemistry Department  
Home Institution: Bradley University  
**Abstract:**  
Previously, the synthesis of poly(μ-caprolactone) (PCL) using a carboxylic acid as an initiator has been reported. Bi-directional initiation of PCL formation with acetylenedicarboxylic acid was attempted to incorporate a triple bond into the center of the polymer, allowing for subsequent participation in coupling reactions with amines or azides. Conditions of the polymerizations were varied, changing monomer and catalyst concentration, solvent, and temperature. Polymerizations were tracked and products were characterized through 1H NMR, LCMS, and ESI-MS analyses. Initiation by trace water with acetylenedicarboxylic acid acting as a catalyst was likely observed. Continuing studies are focusing on polymerizations using trifluoroacetic acid as an alternative catalyst because of its similar pKa value. Adding alcohols as competitive initiators should also provide further insight into the role of trace water.

37. Christian Kunicki  
**BHQ–Cl Caging Molecule**  
Summer Advisor: Mark Distefano  
Sponsor: Lando Summer Research Program  
Home Institution: Minneapolis Community Technical College  
**Abstract:**  
The dominant signaling for cell growth in some cancer cells is through the RAS protein. Ras-protein must be prenylated for this to occur. This is done using Protein Farnesyl Transferase (FTase). Researchers have learned they can stop this process using FTase inhibitors which block the Farnesyl Diphosphate and Ras Protein from entering the FTase. Many of these FTase inhibitors are so effective that they are too toxic for the human body. One way to combat this problem is to cage these FTase inhibitors. Caging will render the drug inactive in the human body until the compound is uncaged locally in the tumor using UVor 2–photon illumination. BHQ–Cl is an effective and efficient caging group. The seven step synthesis of this molecule has been completed.
38. Richard Kurker, Dr. Nathan Wittenberg

**Imaging Calcium in Hirudo Medicinalis Ganglia Using Fluorescence Intensity Ratios**

Summer Advisor: Dr. Christy Haynes  
Sponsor: Lando Program – University of Minnesota Department of Chemistry  
Home Institution: Providence College

**Abstract:**  
Ratiometric calcium imaging is a method that allows for calcium concentration measurement in cells by alternating between two excitation wavelengths and comparing the resultant fluorescence intensities. Of interest is calcium in the ganglia of the invertebrate medicinal leech Hirudo medicinalis. As an invertebrate, Hirudo has a central nervous system consisting of large neurons, making it a convenient model organism for neurochemical studies. We have observed intracellular calcium increases in whole ganglia via stimulation with ionomycin, a calcium ionophore, and digitonin, a membrane permeablizer. Observed calcium increases were mostly in the glial portions of the ganglia. Removal of the glia in subsequent tests did not yield any enhanced neuronal response. Continuing plans include neuronal observation after a 24-hour exposure of live leeches to low-concentration fura-2.

39. Colleen McGourty, Lev Lis

**pKa Determination of Alcohol–Acids in DMSO by NMR**

Summer Advisor: Steven Kass  
Sponsor: Lando/NSF  
Home Institution: Northwestern University

**Abstract:**  
The pKa’s of several alcohol–acids in DMSO have been determined by NMR. A series of alcohol–acids (diol, triol, and tetraol) were created, consisting of an acidic alcohol stabilized with subsequent alcohol groups which stabilize the conjugate base. The overlapping indicator method was performed by synthesizing indicator molecules within two pKa units of the expected alcohol pKa’s, then adding the alcohol to a solution of known concentration of the indicator anion. The shift in equilibrium position was determined by integration of the NMR and used to calculate the pKa of the alcohol. pKa decreases as the number of alcohol groups increases, and the acidities of compounds containing more than four alcohol groups are expected to be sufficient for use in acid catalysis of reactions in non-protic solvents.

40. Benjamin Naab, Sungjun Hong

**Synthesis, Characterization and Reactivity of a Copper–Oxygen Complex**

Summer Advisor: William B. Tolman  
Sponsor: Lando/NSF–REU  
Home Institution: Montana State University–Bozeman

**Abstract:**  
A complex of copper and 1,5-(2,6-di-iso-propylphenyl)-3-nitroformazan was synthesized and reacted with oxygen as a means of gaining a fundamental understanding of copper–oxygen reactivity in biological systems. Various analytical techniques such as resonance Raman spectroscopy, EPR, UV–Vis spectroscopy, low temperature NMR, and X-ray crystallography were used to establish the mechanism, intermediates, and products of the copper–oxygen reaction. The reactivity of the initial product of the copper–oxygen reaction with various organic substrates was then examined as a means of establishing this systems relevance to copper catalyzed bio-oxidations.
41. **Jason Nguyen**, Brandon Winters
*The Effects of Aging Processes on Soot Particle Hydrophobicity*
Summer Advisor: Dr. Jeffrey Roberts
Sponsor: Lando/NSF
Home Institution: Truman State University

**Abstract:**
Soot is known to be active in nucleating cloud particles. The origin of this behavior is unclear because freshly generated soot is hydrophobic. In this work, we explore the hypothesis that oxidative aging of soot causes the conversion of a hydrophobic into a hydrophilic surface. Soot particles were created by burning natural gas in air. The affinity of soot for water was monitored by measuring static contact angles, which were measured as functions of air-to-fuel ratio, oxidation temperature, and time. Preliminary results show that oxidation leads to a decreased static contact angle for water, which in turn suggests a reduction in surface hydrophobicity.

42. **Michael K. Srienc**, Zhifeng Bai
*A Nonionic Surfactant Micelle Shuttle between Water and an Ionic Liquid*
Summer Advisor: Timothy P. Lodge
Sponsor: Lando
Home Institution: Century College

**Abstract:**
Diblock copolymers have previously been shown to form micelles in selective solvents. When these selective solvents form a biphasic system, the micelles can be made to transfer from one phase to another by simply changing the temperature. This has been termed the "micelle shuttle", and may find applications in phase transfer, separation, and catalysis. However, because of the difficulty associated with synthesizing suitable diblock copolymers and their limited availability, it is attractive to try to find an appropriate (and inexpensive) alternative. We have found that the commercial nonionic surfactant Brij 97 can form such a thermoreversible micelle shuttle between water and the ionic liquid 1-butyl-3-methylimidazolium hexafluorophosphate ([BMIM][PF6]) and have characterized the size of the micelles by using dynamic light scattering.

43. **Dana-Marie Telesford**
*Ultrafast Structural Dynamics of Polyaniline at Different Oxidation States by 2D–IR Vibrational Echo Spectroscopy*
Summer Advisor: Aaron Massari
Sponsor: Lando
Home Institution: South Carolina State University

**Abstract:**
Polyaniline (PANI) is one of the most studied conducting polymers, but the correlation between ultrafast structural dynamics and the charge transfer is poorly understood. In this study, the molecular motions in polymers on the ultrafast time–scales relevant to charge mobility will be characterized using two–dimensional – IR vibrational echo spectroscopy (2D–IR VES). Two films of PANI were made with a small percentage by weight of a molecule that is a strong IR absorber. This absorber was embedded into two films, one film conducting and non–conducting. To measure the time–dependent structural dynamics, 2D–IR VES was done on both samples then compared to each other to determine if there were differences between the conducting and non–conducting forms of PANI.
44. **Sara Wenzel**, Kelly Anderson; J. Ilja Siepmann  
*Configurational-bias Monte Carlo Simulations of Mixtures of Linear Alkanes Physisorbed on a Flat Gold Surface*  
Summer Advisor: J. Ilja Siepmann  
Sponsor: Lando/NSF Summer Research Program  
Home Institution: Monmouth College  
**Abstract:**  
Understanding the properties of alkanes physisorbed onto a surface provides insight into the interactions of lubricant systems. Configuration-bias Monte Carlo simulation techniques and the TraPPE (transferable potentials for phase equilibria) force field were used to simulate mixtures of linear alkanes on a smooth Au(111) surface. Mixtures of octane and nonane were studied at five compositions and five temperatures and nonane and decane at three compositions and three temperatures. Molecular level analysis shows that there is strong layering of the alkanes near the solid–liquid interface. Longer alkanes are preferentially adsorbed onto the surface while there is an enrichment of shorter alkanes at the liquid–vapor interface.

45. **James Stokman**  
*Synthesis and Testing of a Novel Antimicrobial*  
Sponsor: Merck & Co.  
Home Institution: University of St Thomas  
**Abstract:**  
As bacteria resistance to current antibiotics continues to increase, new antibiotics must be continually researched and synthesized. My research has been developing and refining a nine step organic synthesis of a novel antimicrobial, modeled off of Zyvox(TM). The main feature of this first generation class of antimicrobials is the oxazolidinone ring, which targets Gram positive bacteria by blocking the ribosomal 50s subunit, effectively preventing translation of RNA to a polypeptide chain. As demonstrated by previous research, it is possible to increase the potency of the antimicrobial by changing the aromatic substituent attached to the oxazolidinone ring. My synthesis utilizes an aminoisothiazole aromatic substituent, which has itself been researched for antimicrobial properties, in the hope of increased antimicrobial potency.

46. **Sarah Hightower**  
*Synthesis of Ladder-Type Oligomers As Organic Semiconductors*  
Summer Advisor: Dr. Daniel Frisbie  
Sponsor: MRSEC  
Home Institution: Pennsylvania State University  
**Abstract:**  
Organic semiconductors are materials with extended conjugated pi-electron systems allowing for delocalization. Both molecular structure and solid state packing are important in realizing useful materials. The project aim is to design new organic semiconductors and to refine the synthesis process. The target molecules are ladder-type fused heterocyclic aromatic compounds structurally related to oligoacenes. These molecules have an emphasis on shape in hopes that they will demonstrate better packing in the crystalline state and produce an increase in charge mobility. These compounds also have various heteroatoms including sulfur, nitrogen, and oxygen. This project involves synthesis, purification, and characterization of the solid state structures of these materials. Crystal structure will be determined when we succeed in growing suitable crystals.
47. Mable McMiller  
*Formation of Lysine–Silica Nanoparticles*  
Summer Advisor: Dr. Michael Tsapatsis  
Sponsor: MRSEC  
Home Institution: Curie High School – Chicago Public Schools  

**Abstract:**  
This research reports on the advanced application of formation of Lysine and Silica nanoparticles which have increased significant attention for preparing silica nanoparticles by addition of TEOS (tetraethylorthosilicate) to an unbuffered, aqueous solution of lysine. The need for well-defined silica nanoparticles has increased and has potentials to meet this need as an immune protection for animal–to–human islet transplantation by producing fabrication of monodisperse of Silica nanoparticles using Lysine in order to adjust the pH of the silica–lysine sols and encapsulating living cells. Researchers have interest in the pig solution to make islet transplantation.

48. Robert Shelton  
*The Impact of Strong Electron Acceptors on Molecular Structure and Solid State Packing of Substituted Oligothiophenes*  
Summer Advisor: Dr. Dan Frisbie and Dr. Mamoun Bader  
Sponsor: MRSEC  
Home Institution: Penn State University  

**Abstract:**  
This project involves the synthesis, characterization and crystal growth of a series of structurally related molecules through the Knoevenagel reaction. The purpose of this work is to investigate the impact of the cyanovinylene groups on the packing patterns of these molecules in the solid state. Previous work in our group on dicyanovinyl and tricyanovinyl groups suggest that strong sulfur–nitrogen interactions tend to force planarity of these materials while the strong acceptor groups resulted in lowering the LUMO levels and induced π–stack formation. Condensation of aromatic aldehydes with acetonitriles through a simple Knoevenagel reaction will be carried out using various commercially available starting materials. Crystal growth by slow evaporation and/or sublimation followed by x–ray single crystal structural analysis will be carried out on those materials.

49. Stuart Kohl  
*Determining the Mechanism for the Ficini–Claisen Rearrangement of Ynamides*  
Summer Advisor: Christopher Cramer  
Sponsor: Minnesota Supercomputing Institute  
Home Institution: University of Minnesota, Morris  

**Abstract:**  
Computational methods were used to examine the addition of allyl alcohol to oxazoladineone and the subsequent claisen rearrangement. The M06 density functional was used along with the MIDI! basis set for all atoms except copper which used the Stuttgart–Dresden pseudopotential. Stationary points were optimized and characterized as minima and transition states using frequency calculations. Both the uncatalyzed and copper catalyzed mechanisms were modeled to lend insight into the reaction and supplement experimental data.
50. **Luyen Nguyen**  
*Synthesis of a Novel Oxazolidinone Antimicrobial*  
Summer Advisor: Dr. J. Thomas Ippoliti (University of St. Thomas)  
Sponsor: NSF STEP Scholarship Program  
Home Institution: University of St. Thomas  

**Abstract:**  
Oxazolidinones, a recent class of antimicrobials, have potent activity against gram-positive bacterial pathogens. A novel oxazolidinone antimicrobial containing a thiaadiazole functional group has been synthesized. The six-step synthesis of this compound starts with the formation of a carbamate and then conversion to an oxazolidinone ring. The following steps transform an alcohol to an acetamide. Its effectiveness against bacterial pathogens was tested against Staphylococcus aureus and Escherichia coli and found to be ineffective when compared to the marketed antibiotic, Zyvox.

51. **Megan Furner**, Ashley Jay, Kyle Kalstabakken  
*Reaction Profiles of Catalyzed and Non-catalyzed Claisen Rearrangements*  
Summer Advisor: Dr. Andrew Harned, Dr. Christopher Cramer  
Sponsor: University of Minnesota  
Home Institution: King's College  

**Abstract:**  
Claisen rearrangements are an atom–economical method for synthesizing substituted carbon–carbon double bonds using a variety of catalysts. However, the reaction results in product inhibition due to the increased Lewis basicity of the products compared to the starting materials. Much needed is a Lewis acid catalyst that is conducive to the enatioselectivity of the reaction and can incur the changes of the reaction. This project concerns the sigmatropic rearrangement product of imidazole-derived alkynes and allyl alcohol. The feasibility of this reaction will be compared by computing the energies and enthalpies of the catalyzed reaction to the non-catalyzed reaction. Metal triflates are currently under investigation as potential catalysts, with special emphasis on copper(II) triflate.

52. **Patrick Hawk**, Dr. Thomas C. Marsh  
*Thiol Place Exchange of Fluorescently Labeled Thiol-Decorated Au Nanoparticles and Disulfides in a Heterogeneous Environment Composed of Aqueous and Organic Layers*  
Summer Advisor: Dr. Thomas C. Marsh  
Sponsor: Young Scholars Program  
Home Institution: University of St. Thomas  

**Abstract:**  
Thiol place exchange on gold is an effective method of creating surfaces for chemical and biological processes. A new method for quantification of this exchange was recently found that involves attaching fluorescently labeled thiols to gold nanoparticles. When they are linked to a nanoparticle, it quenches the fluorescence, preventing photon release. A thiol exchange, however, will replace fluorescently labeled thiols from the nanoparticle, which allows them to fluoresce; this can be used to quantify the place exchange reaction. This is a better method than previously used 1H NMR, which is relatively ineffective (Hong et al., 2006). Previous experiments took place in homogeneous environments; this experiment will attempt to use the method in heterogeneous environments, with aqueous and organic layers, to quantify interfacial place exchange reactions.
53. Godino Kalungi, Albert Kertho, Jaryd Heyer

Extraction and Analysis of Perfluorinated Compounds (PFCs) in an Aqueous Environment

Summer Advisor: Dr. Tony Borgerding
Sponsor: Young Scholars/ NSTEP
Home Institution: University of St. Thomas

Abstract:
Method development was performed to support future work on a food–web study. We have used solid–phase extraction (SPE) coupled with LC–MS/MS to analyze aqueous solutions with known concentrations of PFCs to compare and determine linearity between C18 and XAD–7 solid phases. Signal strength increases linearly with volume of sample in both solid phases. Both C18 and XAD–7 were able to concentrate one liter of sample without breakthrough for a range of perfluorinated alkyl sulfonates and carboxylic acids. We have determined that the detection limit prior to extraction is approximately 1 ppt although it varies slightly for each compound. We are also studying concentration of samples directly into the HPLC column after large volume injection. This technique has been used to analyze samples from Lake Johanna.

54. Louis Sigtermans

Selection of Resistant Individuals Within an Environmental Bacterial Population in Response to Low–level Exposure to an Antibacterial Agent

Summer Advisor: Kris Wammer
Sponsor: Young Scholars
Home Institution: University of St. Thomas

Abstract:
The emergence of antibiotic–resistant bacterial strains is a growing concern worldwide. Because of the possibility of resistance genes transferring between bacterial species, the rise of resistance in environmental bacteria is of interest. This project attempts to determine the effect of exposure to low levels of triclosan (a widely used antibacterial agent) on the selection of resistant environmental bacteria. Bacteria collected from the Mississippi river were grown in bioreactors known as chemostats, exposed to low concentrations of triclosan, and tested periodically for resistance. The bacteria were also analyzed over time for community composition of a highly variable DNA region. We have observed changes in bacteria exposed to 1, 0.5, and 0.1 ìM triclosan concentrations. Future studies include isolating resistant individuals for further DNA analysis.
55. **Matthew Brorby**  
*An Analysis of Neutron Source Data for CDMS*  
Summer Advisor: Priscilla Cushman  
Sponsor: Department of Physics REU  
Home Institution: University of North Dakota  
**Abstract:**  
The Cryogenic Dark Matter Search (CDMS) group analyzes background noise and shield effectiveness for dark matter detectors at the Soudan Mine in northeastern Minnesota. This poster presents results and techniques used to shield the detectors from neutrons. A Californium neutron source was placed at 10, 5, and 0 inches from the outside of the shielding. A simulation was also run under the same conditions in order to verify results and improve simulation techniques. Results were unexpected but the simulation and experimental data agreed with each other giving us further incite into how neutrons are shielded.

56. **Rogerio Fernando Cardoso**  
*Search for Diffuse Material Radio Emission in Cosmological Filaments*  
Summer Advisor: Dr. Lawrence Rudnick, Shea Brown  
Sponsor: Department of Physics REU  
Home Institution: University of Wisconsin – Madison  
**Abstract:**  
Large scale cosmological filaments have been observed to connect galaxy clusters in the cosmic web. Diffuse material, however, has yet to be seen and associated with these filaments. We present a new method to detect diffuse material emission on 21 cm radio maps of the northern sky. The method is based on the differences in the response mechanics of the Very Large Array, an interferometer, and the Stockert telescope at Bonn Observatory, a single dish radio telescope. Preliminary analysis of the maps includes a catalog of 134 candidate diffuse sources, some of which are known galaxies and galaxy clusters. These initial results have verified the validity of our method, allowing for accuracy in the detection of the remaining unidentified diffuse sources.

57. **Deanne Dorak**  
*Lattice Simulations of Supersymmetric Flat Directions*  
Summer Advisor: Marco Peloso  
Sponsor: Department of Physics  
Home Institution: Moravian College  
**Abstract:**  
No Abstract Available

58. **Laura Green**  
*Designing the Polarimeter for the Mount Lemmon Observing Facility*  
Summer Advisor: Terry J. Jones  
Sponsor: Department of Physics REU  
Home Institution: Michigan State University  
**Abstract:**  
Imaging polarimetry of comets is used to explore the nature of comet dust. OptiPol is the current optical polarimeter at the Mount Lemmon Facility, and it utilizes a half-wave plate and calcite Wollaston prism to measure the polarization of celestial objects. OptiPol was built on the cheap, and as a result does not produce the best images for polarimetry. In order to improve the image quality, I designed a new polarimeter. I used ZEMAX to design and optimize the optics and Solid Works to design the mechanical parts to hold the optical components producing a polarimeter that generates a better image quality.
59. Alyssa Hamre
Investigation of the Role of Poynting Flux during Geomagnetic Storms
Summer Advisor: Dr. John Wygant
Sponsor: Department of Physics
Home Institution: Wheaton College
**Abstract:**
Geomagnetic storms cause alterations in the Earth’s magnetosphere such that magnetic reconnection in the magnetosphere’s tail region sets up a steady state dynamo. This dynamo affects the amount of energy transported toward the Earth through various mechanisms, which is later used in energizing particles to create aurora. Data from the Polar spacecraft was used to examine these transportation mechanisms during the May 1998 magnetic storm, looking specifically in the tail region at a distance of 3.0 – 5.5 RE (Earth radii) away. Analysis found that one of these mechanisms indeed appeared to occur at similar times to the influx of energy toward the Earth. Spatial variation of this energy influx on more active days will be an area of further research.

60. Alison Heussler, Cherie Hanavan
Building a Temperature Control Stage
Summer Advisor: Vincent Noireaux
Sponsor: Department of Physics
Home Institution: Augsburg College
**Abstract:**
When working with biological samples it is best to study them at around body temperature, about 37°C. However we also want to look at what happens to our samples at temperatures above and below this average. We need to build a temperature control stage that will work with an inverted microscope and span a range of temperatures, from 15°C to 45°C.

61. Ashikuzzaman Idrisy
Design Study of Oxford Kelvinox100 Dilution Refrigerator
Summer Advisor: Vuk Mandic
Sponsor: Department of Physics
Home Institution: City College of New York
**Abstract:**
Twenty-five percent of the matter in the Universe is dark. The Cryogenic Dark Matter Search (CDMS) is an experiment looking for a dark matter candidate called Weakly Interactive Massive Particles (WIMPs). Using specialized detectors the experiment is attempting a direct measurement of dark matter. At the University of Minnesota we are working on the developments of these detectors. These detectors work around fifty millikelvin. A dilution refrigerator is used to achieve such temperatures. CMDS is planning to upgrade its detectors but, these new detectors might present too much of a weight load for the fridge. The solution requires adding an extra heat load. We report on the calculations done to determine this heat load, and show that the added heat load is not an issue.

62. Nick Sullender
Coupling Microwaves to a Nonlocal Spin–Valve
Summer Advisor: Paul A. Crowell
Sponsor: Department of Physics
Home Institution: Columbia University
**Abstract:**
Spintronics is a field that incorporates electron spin into traditional solid–state devices. Spintronic devices function using flows of electron spins, called spin currents. How these spins propagate through a semiconducting material is an unresolved question in the field. I examine the feasibility of ESR techniques to study this phenomenon.
63. Cody Youmans  
**Designing a QE Measurement System for NOvA APDs**  
Summer Advisor: Dan Cronin–Hennessy  
Sponsor: Department of Physics and Astronomy  
Home Institution: University of Minnesota  

**Abstract:**  
The NOvA (NuMI Off-Axis ν Appearance Experiment) project, utilizing the NuMI neutrino beam at Fermilab, is being designed to detect $\nu_\mu \rightarrow \nu_e$ flavour oscillations. Strategically placed to observe the maximum $\nu_e$ yield from the predicted oscillation events in the beam, the detectors will help us attain essential parameters in the full understanding of neutrino flavour oscillations. Measurement of the final mixing angle $\theta_{13}$ and the CP-violation phase factor are some of its primary goals. The detectors will track neutrino events in active, scintillating material. Light produced will travel through wave shifting fibres to be detected by avalanche photodiodes (APDs). In this paper, a description of software developed in LabVIEW, as well as the acquisition and design of hardware used to test the quantum efficiency of the APDs is presented.

64. Stephen Rudisill, Gagan Aggarwal, Margaret Broz  
**Metal–Oxide Thin Films for LED Applications**  
Summer Advisor: Stephen Campbell  
Sponsor: Electrical & Computer Engineering/NNIN  
Home Institution: Beloit College  

**Abstract:**  
Electroluminescence (EL) of silicon nanoparticles holds promise for a new generation of LEDs. While reported values for EL efficiency are ~1.6%, these numbers could be increased by improving charge delivery to particles with electron and hole transport layers (ETL, HTL). HTL: ZnO and Al-doped ZnO (AZO) thin films were deposited on glass and silicon substrates via ALD. Film properties were characterized with AES, AFM, UV–VIS spectroscopy, profilometry, ellipsometry, and four-point probe measurements; resistivities of $1.75 \times 10^{-3}$ were achieved, maintaining 85% transparency. ETL: NiO and WO3 thin films were deposited in an RF sputtering system. Deposition rates were determined and adjusted for future co-deposition experiments. Oxygen concentration in process gases was found to have a significant impact on NiO film quality and deposition rates.

65. Jamel Alexander, Zak Holman  
**Porosity Studies of Germanium Nanocrystal Thin Films**  
Summer Advisor: Uwe Kortshagen  
Sponsor: MRSEC  
Home Institution: Xavier University of Louisiana  

**Abstract:**  
In this study we are interested in comparing the N2 adsorption/desorption results with those of other previously used techniques (namely SEM and RBS) since the N2 technique is well accepted and the other techniques are not. Digitally reconstructed porous domains contain statistical information well beyond the pore level and thus constitute accurate models that can be used to relate the porosity of these films not only to their microscopic properties, but also to their electrical and optical properties. As part of this study, we would like to measure the porosity of films composed of ~4–5nm germanium nanocrystals and voids (ranging from ~1–55% the density of bulk germanium by other estimates.) The goal of this research is to report a theoretical and simulation study of the temperature dependence of adsorption hysteresis for porous matrices having different morphologies and topologies.
66. Mohammad Bader
Bimolecular Fluorescence Complementation (BiFC) of Enhanced Yellow Fluorescent Protein (EYFP).
Summer Advisor: Wei Shen
Sponsor: MRSEC
Home Institution: Bowdoin College
Abstract:
Enhanced Yellow Fluorescent Protein (EYFP) belongs to a family of naturally fluorescing proteins which have found extensive use as molecular detectors in cell biology. When split to form two approximately equal-sized polypeptides, the individual fragments do not fluoresce. We intend to restore fluorescence by coupling the EYFP fragments in close proximity through complementary nucleotide binding and allowing them to self-reassemble. We will express our proteins in a modified BL21 E. coli host strain which is able to biotinylate a target sequence on the C-terminal and N-terminal fragments. Biotin-streptavidin binding is then used to form complex with a pair of complementary oligonucleotides. After reaction, reconstruction of the fragmented EYFP-streptavidin-oligonucleotide is assessed by fluorimetry.

67. Thomas Briese, Dr. David Giles
High Shear Rheometry for Coating Liquids
Summer Advisor: Dr. Chris Macosko
Sponsor: MRSEC
Home Institution: St. Mary's University of Minnesota
Abstract:
A recent study by Davies and Stokes (J. Non-Newtonian Fluid Mech. 148 (2008) 73–87) has suggested that accurate high shear rheometry is achievable through the use of commercial parallel plate rheometers, so long as the gap setting is very low, on the order of 10 μm. The goal of this project is to reproduce the procedure outlined by Davies and Stokes and assess the accuracy of any data obtained through the use of narrow gap parallel plate rheometry. This research could very well prove to be important for industrial coating processes, as many such processes are performed at high velocities and narrow gaps. These factors, in turn, lead to high rates of shear, making accurate rheological measurements at such high rates all the more desirable.

68. Timothy Beatty, Kurtis Leschkies
Experiments in PbSe Quantum Dot Sensitized Solar Cells Utilizing ZnO Nanowires
Summer Advisor: Eray Aydil
Sponsor: MRSEC
Home Institution: University of California – Santa Barbara
Abstract:
Quantum Dot Sensitized Solar Cells have recently come of interest over traditional Dye Sensitized Solar Cells (DSSCs) because Quantum Dots (QDs) both absorb over a greater portion of the solar spectrum and have the unique characteristic of being able to produce multiple electron–hole pairs for an individual photon. We will be utilizing solar cells consisting of PbSe QDs attached to ZnO nanowires grown from sputtered ZnO because nanowires provide a direct electrical pathway to the photoanode, reducing the possibility of electron–hole recombination, resulting in greater quantum efficiencies and increasing electron transport. The goal of this research is to use novel techniques to successfully create a Quantum Dot Sensitized Nanowire Solar Cell because they may exhibit greater overall efficiencies compared to DSSCs.
69. Jacob Becker  
**Field-Effect Transistors Based on CdSe Nanocrystal Film**  
Summer Advisor: Professor Dan Frisbie  
Sponsor: MRSEC  
Home Institution: University of St. Thomas  
**Abstract:**  
The unique size tunable properties of semiconductor nanocrystals (SC NCs) make them a promising material in the application of future electronics and optoelectronics, where thin film of semiconductor layer is necessary. However, the insulating nature of NCs, especially due to their organic ligand shell, inhibit charge conduction through the film; limiting the application. The goal of this research is to first address this issue and obtain highly conductive NC films and second to understand the electrical properties of the film. A film of CdSe NC doped with Ag in a field-effect transistor configuration will be used to amplify charge carrier concentration. Also, the ability to control the semiconductor charge carrier concentration in a FET will best allow us to understand the film's electrical properties.

70. Brent DeVetter  
**Plasma Synthesis of Silicon–based Nanocrystals**  
Summer Advisor: Steve Campbell  
Sponsor: MRSEC  
Home Institution: University of Wisconsin – Madison  
**Abstract:**  
Silicon nanocrystals (Si-NCs) have a variety of uses in electronics and photovoltaics. For example, bulk silicon is not a useful material for constructing LEDs; however, when it is broken into pieces two to six nanometers in diameter it gains interesting optical properties. A photon will be emitted when an electron and hole recombine due to a UV photon being incident upon the surface. The crystalline size determines the wavelength of the emission. Using plasma to synthesize nanocrystals is an efficient technique. We plan to study the effects of surface damage on the quantum yield of Si–NCs by reducing ion bombardment. To accomplish this, an aluminum shield will be placed within the etching plasma. The ultimate goal is to increase the overall quantum yield of Si–NCs.

71. Matt Gray  
**Fabrication of Sub-micrometer Scale Photonic Crystals Using Soft Lithography**  
Summer Advisor: David Norris  
Sponsor: MRSEC  
Home Institution: University of Michigan  
**Abstract:**  
Photonic crystals have become of interest for many applications including thermovoltaics and optical computing due to the existence of a photonic band gap. The recent developments in lithography have made possible the fabrication of photonic crystals with small enough feature size that a band gap in the visible range of light is possible. Traditional techniques for fabrication of photonic crystals are limited by the poor resolution and thermal stability of photoresists. Likewise, scalability issues obstruct the large scale development and commercialization 3D photonic crystals. The project uses recent discoveries in soft lithography to develop techniques for tungsten photonic crystal fabrication more suitable for conversion to mass production.
72. **Carrington Howard**, Dominique Seetapun

*Analysis of Dynamic Instability of Microtubules by Tracking fluorescent Proteins*

Summer Advisor: Dr. David Odde  
Sponsor: MRSEC  
Home Institution: Howard University  
**Abstract:**

The cell cytoskeleton is responsible for the structure, stability, intracellular transport, and extracellular translocation of the cell. Of the 3 types of fibers that compose the cytoskeleton, microtubules control various cell movements including transport of membrane vesicles, cilia and flagella movement, and chromosome alignment/separation in cell division. A unique feature of microtubules is dynamic instability which allows them to grow and shorten rapidly at opposite ends. Through imaging of fluorescently labeled microtubule-associating proteins (MAPs), the methods by which microtubules lengthen and shorten will be analyzed to further knowledge of ways to influence cell growth and proliferation.

73. **Claire L. Hypolite**

*Bringing Microfluidics and Soft Lithography to the High School Laboratory*

Summer Advisor: Kevin Dorfman  
Sponsor: MRSEC  
Home Institution: Edison High School  
**Abstract:**

Material and equipment costs have prevented new research techniques from being used in high schools. Fortunately, recent research into microfabrication alternatives has considerably reduced the costs of microfluidics and soft lithography. In this project, the classic toy, Shrinky Dinks, is used to make molds formerly created on silicon wafers. The patterns are easily created by printing designs onto the Shrinky Dink plastic using a standard laser printer. When heated, the plastic and the ink patterns shrink to about one-third their original length and width, while becoming nine times thicker. Inexpensive elastomers, such as PDMS, can then be used to create channels and stamps from the Shrinky Dink molds. The result: low-cost, cutting-edge techniques that can be easily used in high school laboratories.

74. **Onuoha Ikoro**, Dave Ellison and Viivek Kalihari

*Probing of the Organic Semiconductor Ultra Thin Film*

Summer Advisor: Daniel Frisbie  
Sponsor: MRSEC  
Home Institution: University Of Minnesota – Twin Cities  
**Abstract:**

The majority of charge transport in an organic semiconductor occurs at the organic semiconductor/insulator interface, within the first few mono layers of the organic film. The morphology of the organic semiconductor at this interface affects the electrical performance of an organic thin film transistor.
75. Melissa Johnson  
**The Characterization of Block Copolymers for Organic Electronic Applications**  
Summer Advisor: Marc A. Hillmyer, C. Daniel Frisbie  
Sponsor: MRSEC  
Home Institution: Missouri University of Science and Technology

**Abstract:**

Organic photovoltaics (OPVs) offer a tractable pathway for solar energy conversion because they are solution processible and their electronic properties can be tuned through manipulating their chemistry. Poly(3-hexylthiophene) (P3HT) is one of the best performing and most studied polymers in the field of organic electronics. While many researchers use P3HT in OPV devices, molecular and structural characterization of the polymer is commonly overlooked and this leads to a large variability in device performance between groups. We will study the molecular and structural properties of block copolymers using size-exclusion chromatography (SEC), differential scanning calorimetry (DSC), and atomic force microscopy (AFM). By studying these polymers in a systematic way, we hope to understand how the molecular and structural properties of the polymers affect device performance.

76. Heather Kumar  
**Progress Toward the Synthesis of a Selective Luminescent Sensor for Time-Resolved Detection of Potassium**  
Summer Advisor: Dr. Marc Hillmyer  
Sponsor: MRSEC  
Home Institution: Florida A&M University

**Abstract:**

Most polymers are currently made from petroleum. Due to the shortage of oil, and its resulting high cost, it is ideal to use a non-petroleum based source as a feed stock for plastics and other polymer materials. We are working in the general area of developing polymer materials from renewable resources, such as crops. The polymer that we are working with is called polylactide, which is derived from corn.

77. Bjorn Lundgren  
**Dye-Sensitized Solar Cells for the High School Chemistry Lab**  
Summer Advisor: Kortshagen/Aydil  
Sponsor: MRSEC  
Home Institution: Coon Rapids High School

**Abstract:**

Dye Sensitized Solar Cells are relatively simple to construct in a research laboratory. Complicated or expensive materials and construction techniques have been modified or eliminated to achieve a DSSC possible for the high school chemistry lab. Iodolyte has been replaced by an electrolyte solution of acetonitrile, potassium iodide, and iodine.
78. Elisabeth Lynn, Andrew Yeckel
*A Theoretical Study of the Effect of the Accelerated Crucible Rotation Technique (ACRT) on CdHgTe Crystals Grown in a Vertical Bridgman System*
Summer Advisor: Jeffery Derby
Sponsor: MRSEC
Home Institution: The University of Arizona

**Abstract:**
The focus of this project is to simulate the growth of single-crystal cadmium mercury telluride (CdHgTe, or CMT), a semiconducting material whose main application is infrared detection. In a vertical Bridgman system the material is heated to a temperature above its melting point and then slowly translated through a decreasing temperature gradient, causing the melt to solidify. By implementing the ACRT mixing is enhanced in the melt, reducing compositional non-uniformities which is vital for crystal functionality. The system is modeled using equations of fluid flow, heat and mass transfer, and solid-liquid interface shape. The model, Cats2D, uses the Galerkin/finite element method to discretize the partial differential equations.

79. Leslie McGourty
*Creating Dye Sensitized Solar Cells for the Physics Classroom*
Summer Advisor: Eray Adyiil
Sponsor: MRSEC

**Abstract:**
Traditional solid state solar cells do not help to fix the current energy crisis we are experiencing. In order to create an efficient and productive type of cell new materials must be explored. Nanocrystalline dye-sensitized solar cells are a promising technology to help solve our current energy dilemma. Nanoparticles offer advantages over traditional designs. Nanometer sized objects have large surface areas, possess unique optical and physical properties, and are relatively inexpensive. Currently dye-sensitized nanocrystalline TiO2 solar cells have created conversion efficiencies of sunlight to electrical power of more than 10%. We will be using “homemade” dye, found in various organic substances, including blueberries and raspberries, to see how they behave as dyes and to determine if electrical output can be increased. In addition, we will be varying TiO2 film thickness to see what effect, if any, it has on electrical power output. The goal of this research is to create a step by step laboratory experiment that uses simple, inexpensive ingredients for students to create their own solar cells. From there a myriad of inquiry based labs can be performed that can enhance students’ knowledge about optics, electricity, and quantum phenomena.

80. Christopher Pyawasit
*Minimizing the Staebler–Wronski Effect in Amorphous Silicon Film*
Summer Advisor: Professor James Kakalios
Sponsor: MRSEC
Home Institution: College of Menominee Nation

**Abstract:**
In the search for alternate energy sources, we continue to try to improve some of our known resources. One of these valuable and highly potential resources is the well known solar power. During this era of international research toward the affects of global warming within our atmosphere, there has been found a reversible photoelectric effect that decreases both photoconductivity and dark conductivity within solar cells. Amorphous Silicon produced by glow discharge Silane is used to fabricate thin solar cells with improved efficiencies. This material has proven it has high optical absorption within the visible light spectrum and our ability to control its conductivity with dopants. These techniques offer a hopeful cost effective, more efficient solution to our valuable natural resources.
81. Kayla Reibel, Alex Lee
*Effect of Diameter on Band Pattern Formation of Silica Nanoparticles*
Summer Advisor: Michael Tsapatsis  
Sponsor: MRSEC  
Home Institution: Tri-State University

**Abstract:**  
Films of silica nanoparticles have many applications in diverse fields such as molecular separations and electronics. In the process of producing coatings of silica nanoparticles by convective assembly, an interesting phenomenon occurs where the silica nanoparticles form a periodic band pattern instead of covering the glass substrate. The band pattern will be studied to see the effect of particle diameter on the spacing between the bands. Silica nanoparticles of different sizes will be grown and coated onto a glass substrate. The spacing of the bands will be observed with the scanning electron microscope. After producing and analyzing the particles and coatings, the spacing of the bands will be able to be predicted based on particle size.

82. Emmanuella Rony, Noelle Palumbo, Lakshmi Nagarajan
*Targeting Antigen Presenting Cells for Vaccine Delivery*
Summer Advisor: Chun Wang  
Sponsor: MRSEC  
Home Institution: Florida A&M

**Abstract:**  
Dendritic cells (DCs) are a special type of antigen-presenting cells that are capable of ingesting foreign materials (antigens), thereby stimulating antibody production and cellular immunity. DCs are found in the skin, inner lining of the nose, lungs, stomach, intestines, spleen and lymph nodes. DCs can also be found in the blood in an immature state. The goal of this research is to develop polymer particles as carriers for delivering DNA vaccine specifically to DCs, while avoiding other non-DC cells. To accomplish this long-term goal, it is important to understand how different cell types take up polymer particles with different sizes. In this summer project, we investigated how DCs and other types of cells such as macrophages, fibroblasts, and epithelial cells take up particles 1 μm and 100 nm in diameter *in vitro* and quantified and compared the dependence of particle uptake on cell type and particle size. This preliminary work will provide important insight for developing better vaccine delivery systems.

83. Shalene Sankhagowit
*Delivery and Controlled Release of Drugs into Cancer Cells using pH-Sensitive Liposomes*
Summer Advisor: Professor Efie Kokkoli  
Sponsor: MRSEC  
Home Institution: University of Minnesota – Twin Cities

**Abstract:**  
The usage of pH-sensitive liposomes provide as a method for controlling the release of encapsulated contents such as drugs to combat cancer cells. Under physiological conditions, a pH-sensitive liposome is stable, but it quickly deteriorates in more acidic environment during endocytosis. The capability of a liposome is enhanced via various methods: steric stability and lengthened bloodstream circulation time are facilitated by incorporating poly(ethylene glycol) to the liposome surface. Furthermore, attached are fibronectin–like peptide sequences seeking specifically an integrin over–expressed by colon cancer cells. Fluorescent marker contained inside the liposomes is the means for characterizing pH-sensitive liposome functions in CT26 colon cancer cells. Data from flow cytometry and confocal imaging demonstrates the efficacy of this method of targeting water–soluble drug delivery.
84. **Leif Segen**  
*Quantitative FRAP Measurements of Lipid Bilayers*  
Summer Advisor: Ben Stottrup (Augsburg College), Xiaoyang Zhu  
Sponsor: MRSEC  
Home Institution: Rutgers University  
**Abstract:**  
A fundamental issue in biophysics is the nature of lipid bilayers. They are what cell membranes are comprised of, and are therefore of importance in developing drug delivery systems. These bilayers serve also serve as a great model for boundary mechanics and cell membranes are important areas in modern research. This serves as model for boundary mechanics. Lipids chosen for their liquid and gel states are being studied with interfacial force microscopy. In parallel to this study is the development of a system for quantitative lipid bilayer diffusion experiments using fluorescence recovery after photobleaching (FRAP). Pedagogical research is also a driving force, in that a lab assignment for undergraduate students is being established.

85. **Garrett Swindlehurst**, Jinping Dong, Greg Haugstad, Chris Frethem, John Foley, Bob Hoerr  
*Characterization of Real–time Drug Release from Engineered Biomedical Coatings*  
Summer Advisor: Jinping Dong, Greg Haugstad  
Sponsor: NNIN REU  
Home Institution: North Carolina State University  
**Abstract:**  
Controlled drug release from biomedical coatings is of specific interest to engineers designing internal medical devices. However, the release mechanisms and the design parameters affecting them are poorly understood. Composite coatings of polyisobutylene-polystyrene polymer with 10% (wt/wt) dexamethasone or rapamycin, both anti-inflammatory drugs, were generated on a stainless steel substrate using the ElectroNanospray™ process. These coatings were then analyzed using atomic force microscopy (AFM) and confocal Raman spectroscopy imaging. The sequestration of the drug in air and the release of the drug in solution over time were observed with both techniques. Subsequent characterization of this release process will allow engineered coatings with specific release profiles. These coatings can then be applied to arterial stents to prevent scar tissue accumulation after surgery.

86. **Sarah Cook**, Dr. Aurore Thibon, Dr. Valerie Pierre  
*Progress Toward the Synthesis of a Selective Luminescent Sensor for Time–Resolved Detection of Potassium*  
Summer Advisor: Dr. Valerie Pierre  
Sponsor: NSF Lando  
Home Institution: Ohio Wesleyan University  
**Abstract:**  
Potassium (K⁺) is an essential nutrient, involved in the muscular and nervous systems as well as regulation of cellular activity. Biologically relevant K⁺ concentrations are 3.5–5.3 mM in the blood and 100–140 mM in cells. These concentrations are difficult to measure because sodium (Na⁺) is 25 times more prevalent than K⁺ in the blood. Currently, no sensor has adequate selectivity for K⁺ over Na⁺ or sufficient luminescence lifetimes for quantifying potassium concentrations in complex biological mediums. To address these problems, a lanthanide–based sensor is being developed whose selectivity for K⁺ is a result of cation–π interactions. The use of a lanthanide complex lengthens the luminescence lifetime of the sensor, thus allowing for the quantitative measurement of potassium. Synthesis of the sensor is in progress.