Materials Research Science and Engineering Center

UNIVERSITY OF MINNESOTA

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Summer Undergraduate Research Expo

August 9, 2012
McNamara Alumni Center
Memorial Hall
4:00-6:00pm

Undergraduate Poster Presentations
Listed Alphabetically by Presenting Author

1.	**Evan Beacom** *Synthesis of Imidazole Derivatives* **Advisor:** Dr. J. Thomas Ippoliti **Department or Program Sponsoring Summer Research:** University of St. Thomas Chemistry Department **Home Institution:** University of St. Thomas **Abstract** Imidazoles and imidazole derivatives have been found to play significant roles in many biological systems, particularly in enzymes, as proton donors and/or acceptors, and as coordination system ligands. Because of these and several other known applications of these molecules, imidazole derivatization has been quickly developing and expanding in recent years. The purpose of this project has been to synthesize several of these derivatives by the addition of amine substituents. This is done by two main experimental procedures: reductive amination by palladium-catalyzed hydrogenation and imine formation.
2.	**Rebecca Berger**, Karen Haman *Amphiphilic Block Copolymer Interactions with Biological Model Membranes* **Advisor:** Frank Bates **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Mount Holyoke College **Abstract** Cell membrane lipid layers, comprised of lipids, proteins, and cholesterol, are susceptible to the formation of stabilized pores, which compromise membrane integrity. This work focuses on the use of commercially available, amphiphilic block copolymers, specifically Pluronic F68, consisting of poly(ethylene oxide) and poly(propylene oxide) blocks, to seal permeablized cell membranes. The underlying physical mechanism of membrane sealing is not yet understood, though it is known that block copolymer molecular weight and chemical composition are critical to polymer integration into the amphiphilic lipid bilayer. By using model cell membranes derived from rabbit skeletal muscle tissue, we hope to gain a physiologically relevant understanding of the interaction between the model membrane and Pluronic F68. We will use a Langmuir trough to investigate polymer interactions with lipid monolayers and to verify polymer insertion and persistence in the monolayered membrane model. We will simultaneously visualize the resultant membrane morphologies using fluorescence microscopy. Finally, we will determine the impact of subphase composition on the behavior of monolayered membrane models by investigating several subphase formulations.
3.	**Amanda Bowers** *Fiber Test Analysis and Test Consolidation among The Stringing Fiber Test, Visual Test, MSU Laser Test, and Camera Test performed on NOvA Far Detector Modules* **Advisor:** Dr. Greg Pawloski **Department or Program Sponsoring Summer Research:** University of Minnesota- Department of Physics; National Science Foundation **Home Institution:** Linfield College **Abstract** In an effort to better understand the fiber-optic technology used to read out information regarding the masses energies and the mixing angles of neutrino flavors, various tests are performed at multiple stages of the module production process. These fiber tests are used to check for damaged fibers to prevent final production of a detector comprising bad channels that may yield faulty readings. It is currently unclear exactly where along the production process damage occurs and the direct cause of most damage is unknown. Analysis of the Stringing Fiber Test (SFT) suggests that high tensions below the threshold constituting restring are not a likely source of damaged fibers. However, the analysis also suggests that something systematic during stringing leads to inconsistencies between extrusions.
4.	**Kristin Braden** *Charge Density and Stereochemistry Affect the Interaction of PAMAM Dendrimer with Glycosaminoglycans* **Advisor:** Dr. Lisa E. Prevette **Department or Program Sponsoring Summer Research:** Department of Chemistry **Home Institution:** University of St. Thomas **Abstract** Cell-penetrating compounds, such as polyamidoamine (PAMAM) dendrimer, are often attached to drugs to induce cellular uptake. We hypothesize that electrostatic interaction occurs between the positively charged primary amines of PAMAM and negatively charged glycosaminoglycans (GAGs) found on all cell surfaces to different extents. The interactions between generation 5 PAMAM dendrimer and four GAGs have been studied using isothermal titration calorimetry (ITC), dynamic light scattering (DLS), and gel electrophoresis. ITC experiments revealed the binding thermodynamics. DLS was used to confirm complex aggregation. Competitive displacement of DNA cargo from PAMAM by the individual GAGs was studied using gel electrophoresis. It has been determined that PAMAM-GAG affinity is dependent upon GAG charge density and stereochemistry. GAGs can disrupt PAMAM-DNA complexes, which has implications at the cell surface.

5.	**Brooke Capelle** *Synthesis of a Novel Yellow Thermochrome* **Advisor:** Dr. J. Thomas Ippoliti **Department or Program Sponsoring Summer Research:** University of St. Thomas Chemistry Department **Home Institution:** University of St. Thomas **Abstract** Thermochromic compounds change color based on temperature. The color of the thermochromatic compound is affected by structure The goal of this project was to carry out the synthesis of a variety of aromatic fused lactones with different structures to ultimately form a yellow thermochrome. These substituted lactones change from colorless to colored upon cooling in the presence of a phenol (developer). Thermochromes were synthesized via a metal halogen exchange by the reaction of n-butyllithium with a brominated aromatic compound to create a carbon nucleophile. This was followed by addition of the nucleophile to various anhydrides. Finally, the reaction was quenched with water to give a lactone. Several thermochromic compounds were synthesized; including yellow, teal, cream, and sea foam colored thermochromes.
6.	**Matthew E. Caplan** *Photometry of Local Group Dwarf Galaxies: A comparison to published results* **Advisor:** Kristen B. W. McQuinn **Department or Program Sponsoring Summer Research:** School of Physics and Astronomy - REU **Home Institution:** University of Virginia **Abstract** A complete census of evolved asymptotic giant branch (AGB) stars in 50 local group dwarf galaxies was obtained with the Spitzer Infrared Space Telescope instrument at 3.6 and 4.5 μm. As part of this larger project, we have performed photometry on a set of 7 galaxies and compared the results with previously published photometry after correcting for zero-point magnitudes, color, array location dependence, and pixel phase dependence. Our results generally agree, but we find a magnitude offset of approximately 5%.
7.	**Denise Casemore**, Alireza Shokri *Heptaol 2.0: Synthesis of 7-(hexane-3,6-diol)tridecane-1,4,7,10,13-pentol* **Advisor:** Steven R. Kass **Department or Program Sponsoring Summer Research:** Lando/NSF Summer Research Program **Home Institution:** University of Minnesota Morris **Abstract** In order to increase the stability of the hydrogen bond network formed between the primary and secondary alcohols in the heptol 5-(butane-2,4-diol)-nonane-1,3,5,7,9-pentol, a new heptol was synthesized 7-(hexane-3,6-diol)tridecane-1,4,7,10,13-pentol. This heptol contains additional carbon spacers between the alcohol groups which offer new flexibility to the hydrogen bonds that would stabilize the deprotonation of the tertiary alcohol. Its acidity and binding affinity for chlorine ions can be measured by NMR and compared to that of heptol 5-(butane-2,4-diol)-nonane-1,3,5,7,9-pentol. If these results are as expected and the hydrogen bond network is further stabilized, this molecule has the potential to be used as a catalytic alternative to some Bronsted acids or even to be developed into a sensor to monitor cellular ion concentrations.
8.	**Brandon Cavness**, Angeline Klemm, Xiaohui Chao *Development of Spin-transfer Electronic Nano-Devices* **Advisor:** J.P. Wang **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Angelo State University **Abstract** Spin transfer torque (STT) based all-spin logic and spin transfer nano oscillator (STNO) devices show promise for replacing technologies since they have the beneficial effects of reduced power consumption and nonvolatility. Both devices utilize fixed and free magnetic layers. STT is used in all-spin devices to change the orientation of the free magnet layers between antiparallel and parallel configurations to produce high and low resistances, respectively. STNOs are based on the precession of the free layer, which generates a high frequency voltage signal. These devices were fabricated and programs were developed for both devices for testing and interpreting data. Our current results are the fabrication of an all-spin logic device and program which successfully fits data from our STNO's to a Lorentzian fit.

9.	**Jiajie Cen**, Mayank Puri *Synthesis and Characterization of Two New Non-heme Iron Complexes: An Investigation into the Influence of Ligand Steric Bulk* **Advisor:** Lawrence Que **Department or Program Sponsoring Summer Research:** Department of Chemistry, University of Minnesota **Home Institution:** Nanjing University **Abstract** High-valent iron-oxo species are proposed to be the active intermediates in many reactions carried out by non-heme iron enzymes, including the hydroxylation, halogenation and desaturation of organic substrates. Synthesizing well-described model compounds can provide vital insights into the structures of such enzymes and the mechanisms of their reactions. Two new polypyridyl-pentadentate ligands with increased steric bulk were synthesized, by introducing a methyl substituent on the α-carbon of one pyridine ring and by replacing one pyridine ring with a quinoline ring. Metallation and generation of iron(IV)-oxo species from these ligands demonstrated an increase in reactivity, as shown by a decrease in half-life from 6 hours to 7 minutes at room temperature, compared to the underivatized complex.
10.	**Kyle Chamberlain**, Ryan Smith *Quantitative Determination of DNA Affinity for PEGylated Polycationic Gene Delivery Vehicles* **Advisor:** Lisa Prevette **Department or Program Sponsoring Summer Research:** Department of Chemistry **Home Institution:** University of St. Thomas **Abstract** Polycations have become popular non-viral gene delivery agents due to their easy synthesis and ability to carry large amounts of DNA. To prevent toxic side effects and aggregation seen in physiological conditions, polyethylene glycol (PEG) is conjugated to the polymers to mask their charge. Unfortunately, high PEG conjugation ratios can inhibit DNA binding and compaction. To optimize a polymeric gene delivery agent's effectiveness, an ideal PEG length and ratio of PEG to positive charge must be found. This study has used electrophoretic mobility shift and ethidium bromide exclusion assays to determine a proper PEG length and conjugation ratio for generation 5 polyamidoamine (G5 PAMAM) dendrimer and linear polyethylenimine (PEI). Results indicate conjugation of PEG chain lengths below 5000 MW may actually promote PAMAM-DNA binding.
11.	**John Christensen** *Identifying Fluids for Tuning and Cooling Radio Frequency Devices Operating in the X-Band* **Advisor:** Dr. Rhonda Franklin **Department or Program Sponsoring Summer Research:** Electrcial and Computer Engineering **Home Institution:** University of Minnesota -- Duluth **Abstract** The objective is to identify fluids with potential to be used as heat transfer mediums and tuning materials in micrometer-sized radio frequency devices. Fluids used in these types of devices must exhibit dielectric properties with low loss tangent values in the X-Band (8 - 12 GHz) spectrum. Because of the dimensions, the fluids must have viscosities similar to water. Fluids are identified based on meeting two of the following known characteristics: viscosity similar to water, existing use in heat transfer applications, or compatibility with electronic devices. The fluids will be analyzed using a transmission line connected to a network analyzer. The collected S-parameter data will be used to calculate the εr (relative permittivity) and tan δ (loss tangent) values of the fluids using the geometry of the transmission line.
12.	**Megan Claflin**, Bryan Paulsen *Structure-Property Relationships of Conjugated Copolymers for Photovoltaic Applications* **Advisor:** Prof. C. Dan Frisbie **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Minnesota State University, Mankato **Abstract** Organic photovoltaics, based on solution-processable conjugated polymers, are among the most promising candidates for flexible, lightweight, and inexpensive devices. The ultimate advantage of these devices is their potential to be easily fabricated in a high volume 'roll-to-roll' manner from low cost materials. To obtain maximum device efficiency it is critical to optimize the physical and optoelectronic properties of the semiconducting "active" material (e.g. solubility, band gap, HOMO/LUMO, carrier mobility, absorption strength, stability). Conjugated polymers are particularly attractive due to their unique properties which are synthetically tunable. This work investigated statistical (random) copolymerization, of structurally and electronically distinct monomers, as a synthetic route for tuning various material properties. Overall, the aim was to broaden the understanding of the fundamental structure-property relationships of the copolymer materials.

13.	**Wendy Consoer**, Dan Kellen and James Byrnes *Effects of Ozonation on the Antibacterial Activity of the Macrolide Antibiotic Roxithromycin* **Advisor:** Kristine Wammer **Department or Program Sponsoring Summer Research:** Chemistry **Home Institution:** University of Saint Thomas **Abstract** With the increase of antibiotics detected in surface water, it is very important to understand what happens to these antibiotics throughout the drinking water treatment process, in particular whether or not antibacterial activity is removed. This study examines the effects of ozonation on roxithromycin. Previous studies have suggested some ozonation products of roxithromycin may retain antibacterial activity. In this study, roxithromycin solutions were treated with aqueous ozone. Ozonated solutions were analyzed using HPLC, and products were screened for antibacterial activity with a biological assay using Staphylococcus epidermidis. So far, no products of ozonation have shown antibacterial activity. Previously the study was focused the role of varying pH on product formation; currently the role of dissolved organic carbon is being investigated.
14.	**Katelyn Dahlke**, Matt Petersen *Synthesis and Characterization of PMDO for use in Targeted Drug Delivery* **Advisor:** Dr. Efie Kokkoli **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Iowa State University **Abstract** Targeted drug delivery has been explored as a viable option to better control treatments for diseases, such as cancer, by targeting specific characteristics that are enhanced in diseased cells. Amphiphilic diblock copolymers, which self-assemble in water into aggregates with a variety of morphologies including hollow vesicles capable of encapsulating a variety of therapeutics, show to beare promising vessels for use in targeted drug delivery. While previous studies have been done with a variety of hydrophobic polymers including poly(γ-methyl-ε-caprolactone), a polymer with better degradability properties is ideal for triggered intracellular release. The zinc-catalyzed polymerization of 2-methyl-1,3-dioxan-4-one (MDO) was studied and optimized for use in such a block copolymer, poly(ethylene oxide)-block-PMDO. The resulting diblocks' self-assembly properties in aqueous solutions were studied to find the optimal ratio of the hydrophobic to hydrophilic blocks for v esicle formation. Due to the immobility of the diblock polymer in aqueous solutions, ditriblock co-terpolymers of PEO-block-(PMDO-co-PLA) are being investigated as an alternative to the traditional A-B diblock.
15.	**Scott Danielsen**, Can Zhou *Efficient Formation of Multicomponent Ion Gels by Stepwise Self-Assembly of Thermoresponsive ABC Triblock Terpolymers* **Advisor:** Prof. Tim Lodge **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Pennsylvania **Abstract** The gelation behavior of a poly(ethylene-alt-propylene)-b-poly(ethylene oxide)-b-poly(N- isopropyl acrylamide) (PON) triblock terpolymer in a room-temperature ionic liquid, 1-butyl- 3-methylimidazolium tetrafluoroborate ([BMIM] [BF4]), will be studied by rheology over the concentration range 1-10 wt%. We expect to see gelation of the PON terpolymer at a much lower concentration and with a sharper sol-gel transition than comparable ABA triblock copolymers. We believe this is due to a stepwise gelation of PON terpolymers involving micellization at elevated temperatures and gelation at lower temperatures, which results in a two- compartment network that we hope to observe.
16.	**Jaen K. De Leon** *Boolean-based Detailed Router for FPGA* **Advisor:** Sachin S. Sapatnekar **Department or Program Sponsoring Summer Research:** Electrical and Computer Engineering Department, NSF **Home Institution:** University of Puerto Rico, Mayaguez Campus **Abstract** FPGA have been used widely for many applications that include from defense systems to medical equipments. Given that a FPGA is an integrated circuit that is limited by the amount of components that it have and that applications are becoming bigger and more complex, it have been a challenge to find ways to use better the FPGA resources. The main problem of this limitation is to predict when a given netlist can fit on a specific FPGA architecture in terms of whether it can be routed successfully after placement. The Boolean-based detailed router presents another approach to verify if a given circuit netlist can be routed to a given FPGA architecture, and if is possible, then set the specific tracks of each channel that each net will be connected. With this approach, I was able to predict when a circuit netlist can be place and routed on a FPGA architecture.

17.	**Leon Dean**, Julian Sheats *DNA Extension in Nanochannels* **Advisor:** Kevin Dorfman **Department or Program Sponsoring Summer Research:** NNIN **Home Institution:** University of Texas at Austin **Abstract** Confining DNA in nanochannels has proven to be a useful technique for stretching single DNA molecules. Because DNA is a semiflexible polymer, classical Odijk and de Gennes confinement behavior only apply as limiting cases. Monte Carlo simulations have suggested that there are two additional confinement regimes between the Odijk and de Gennes regimes for DNA in a high ionic strength buffer. The purpose of this study is to measure the fractional extension of λ-DNA as a function of nanochannel width in these transition regimes and to compare these experimental results to the aforementioned simulation results. Several nanofluidic devices containing arrays of nanochannels with widths between 50 and 500 nm were fabricated and preliminary extension measurements were made.
18.	**James Delles**, Andrew Galkiewicz *Kerr Microscopy of Spin Currents in Metallic Nanowires* **Advisor:** Paul Crowell **Department or Program Sponsoring Summer Research:** Physics REU **Home Institution:** California State University, Chico **Abstract** When a beam of polarized light is reflected off a magnetized surface, the angle of polarization of the light changes with regards to the magnitude and direction of the magnetization. This is known as the magneto-optic Kerr effect. A spin valve is a device in which current is passed through a ferromagnet and due to the density of states of the electrons in the ferromagnet, the leaving current is all of the same spin direction. It should be possible to use the Kerr effect to measure this spin current created in a nanowire from ferromagnets with their magnetization being out of the plane.
19.	**Dana Dement**, Melissa Johnson, Dr. Michael Manno *Characterization of Cu2ZnSnS4 (CZTS) Thin Films for Photovoltaic Devices* **Advisor:** Prof. Eray Aydil and Prof. Chris Leighton **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Rice University **Abstract** Thin film photovoltaic devices are attractive because they possess both direct bandgaps and high absorption coefficients. This results in the need for much less material compared to silicon based cells. Currently, however, most thin film devices contain relatively rare and expensive materials that could be a barrier to large-scale commercial deployment. An appealing alternative is Cu2ZnSnS4 (CZTS) based solar cells, which utilize both non-toxic and more abundant elements. In this project, precursor Cu-Zn-Sn films were deposited via co-sputtering. The films were then sealed in an evacuated quartz ampoule and sulfidized at elevated temperatures (600°C). By changing the ratios of Cu, Zn and Sn in the precursor films and studying the resulting morphologies, better control and understanding of the fabrication process can be obtained. X-ray diffraction and Raman spectroscopy were used to identify CZTS, along with other secondary phases, and were supplemented with scannin g electron microscopy. Ultimately, we hope this will bring us closer to developing impurity free, phase controlled CZTS devices.
20.	**Yvonne DePorre** *Kinetic Studies of ε-caprolactone with Al-salen Complexes* **Advisor:** **Department or Program Sponsoring Summer Research:** **Home Institution:** Michigan State University **Abstract** Polylactic acid (PLA) is a renewable and biodegradable polymer that is used for picnicware and food packaging. Cornstarch is converted through several biochemical steps into the monomer lactide (LA), which is catalytically polymerized into PLA. The monomer ε-caprolactone (CL) polymerizes by the same two-step mechanism as LA, and is used as a model because it polymerizes faster. Aluminum-Salen catalysts were synthesized, differing only in their substituents: -OMe (electron donating), -Br (electron withdrawing), and –NO2 (extremely electron withdrawing). Changing substituents changes the electronic environment of the metal center, which affects both steps of the polymerization. Previous studies measured the overall rate, but did not provide detail into the two kinetic steps. This study uses high monomer concentration to determine the rates of these two steps independently.

21.	**Sam Di**, Yao Wang *Magnetic Recording Detection for Bit-Patterned Media* **Advisor:** Randall Victora **Department or Program Sponsoring Summer Research:** Electrical and Computer Engineering **Home Institution:** University of Mississippi **Abstract** Bit-Patterned Media is a magnetic storage technology currently being studied to increase magnetic recording densities. In patterned media, small track pitches can result in inter-track interference (ITI) in addition to inter-symbol interference (ISI). These forms of interference may significantly distort readback signals from the media. This project focuses on using a generalized partial response equalizer to reduce the effects of ISI. Equalizer and partial response target values were set using Minimum Mean Square Error (MMSE) criterion. Simulations were run for the case of single track (no ITI present) and bit error rates (BER) were examined. Future work includes the design of a two-dimensional generalized partial response equalizer to reduce the effects of both ISI and ITI.
22.	**Adam Eldeeb** *Variability of Macro Invertebrate assemblage in Streams* **Advisor:** Diana Dalbotten & Jessica Kozarek **Department or Program Sponsoring Summer Research:** St. Anthony Falls Research Laboratory **Home Institution:** University of Minnesaota **Abstract** The variability of macro invertebrates, which includes both surface waters and sub surface waters, will be examined in an artificially created stream in Minneapolis, Minnesota. We will be analyzing system size relativity, species identity, and water flow rate within a stream that is a representative sample of the Mississippi River. My study will include three different sections of the Outdoor StreamLab, all of which will include the stream itself. We will expect that there be a significant difference in variability as well as assemblage structure within these species. We will expect a result with high flow rate influence (the amount of water moving over a point over a fixed period of time) as well as overall water levels of the individual areas of the stream.
23.	**Wey Foo** *Isomerization of Glucose to Fructose through the use of zeolite* **Advisor:** Dr. Michael Tsapatsis **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Minnesota - Twin Cities **Abstract** Numerous strategies are currently under development for the isomerization of glucose to fructose and amongst these strategies include the use of zeolites, which exists in over a hundred different framework types. By the use of zeolites for the isomerization of glucose to fructose, and the further dehydration of fructose in dimethyl sulfoxide (DMSO), extraordinarily high selectivity of HMF of up to 92% has been reported. Through the adoption of specialized analytical techniques and equipment such as the High Performance Liquid Chromatography (HPLC) used to study the retention time of fructose, insight that will contribute toward the development of a more efficient overall conversion of glucose to HMF by the application of a highly selective catalyst can be established.
24.	**Danielle Francen** *Tat peptide-mediated Gene Delivery: Complex Formation and Interaction with Cell-surface Glycosaminoglycans* **Advisor:** Lisa Prevette **Department or Program Sponsoring Summer Research:** Department of Chemistry **Home Institution:** University of St. Thomas **Abstract** Gene therapy consists of the delivery of foreign DNA to cells. Cell penetrating compounds, such as Tat peptide, have been shown to facilitate DNA delivery through the formation of a Tat/DNA complex. Different complex +/- ratios were tested using an electrophoretic mobility shift assay with the goal of finding the ratio at which Tat fully binds DNA. Complex size was determined in various solvents using dynamic light scattering. Positively charged Tat was found to interact electrostatically with negatively charged cell surface glycosaminoglycans (GAGs). A competitive displacement assay was conducted to find the concentration of GAG needed to completely displace DNA from the Tat/DNA complex. Results support Tat-GAG affinities measured by isothermal titration calorimetry (ITC) and lend insight into potential cell uptake mechanisms of these complexes.

25.	**Mark Frommelt** *Synthesis of Hyperpolarizable Molecule Containing a Photochromic Switch Leading to Absorption in the Near Infrared Region* **Advisor:** Dr. Ippoliti **Department or Program Sponsoring Summer Research:** University of St. Thomas Grants and Research Office **Home Institution:** University of St. Thomas **Abstract** The goal of this summer's synthesis was to create a molecule that contains a photochromic switch to activate a chain of conjugation leading to absorption at the near Infrared level of electromagnetic radiation. So far this molecule has yet to be synthesized. However, many key intermediates have been produced to get to the final product. These intermediates include: methanone di-2-thienyl, propanedinitrile 2-(3-cyano-4,5,5 trimethyl-2(5H)-furanylidene), 6-hydroxy-2-napthalenecarboxaldehyde and others. The next step is to combine these molecules to create an extremely large hyperpolarizable molecule utilizing the electron donating sulfur groups of the methanone di-2-thienyl and the electron withdrawing cyano groups on the propanedinitrile 2-(3-cyano-4,5,5 trimethyl-2(5H)-furanylidene).
26.	**Dominique Gautreau**, L. O'Brien, D. Spivak *Characterization of Ni/Cu lateral spin-valves* **Advisor:** C. Leighton, P. Crowell **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Louisiana State University **Abstract** To improve storage density in hard drives, smaller read and write heads must be developed. Investigating the dynamics of spin currents in magnetic devices is vital to developing new spin-based electronics, including smaller read heads for hard disk drives. Lateral spin valves are used to probe the dynamics of spin currents at the ferromagnetic-nonmagnetic interface and spin relaxation through a non-magnetic channel. The change in non-local resistance as a function of temperature has been found in literature to be non-monotonic in certain FM and NM combinations, particularly NiFe and Cu. NiCu are tested for this non-monotonic trend.
27.	**William Gaviria**, Richard Liptak *The Effects of Surface Passivation on Trap Levels in Silicon Nanocrystals* **Advisor:** Stephen Campbell **Department or Program Sponsoring Summer Research:** NNIN, NSF, Electrical and Computer Engineering Dept. **Home Institution:** Massachusetts Institute of Technology **Abstract** Si nanocrystals (Si-NC) systems have a wide variety of applications due to their optical properties and recent developments have allowed for the synthesis of Si-NCs that are resistant to oxidation through surface passivation. However, the effects of surface passivation on the electronic properties of Si-NCs remain unknown. With this in mind, our research focused on the investigation of trap levels in Si-NCs and the effects of passivation on these traps. The Si-NCs were created using non-thermal plasma synthesis and were deposited in MOS Capacitor devices. The trap centers of our fabricated MOS structures were then investigated using CV profiling and Deep Level Transient Spectroscopy (DLTS) in order to confirm the presence of traps as well as to characterize the energy level and trap cross-section of these trap centers.
28.	**Tom Gentle** *Synthesis of a Novel Polymerizable Isoluminol Derivative* **Advisor:** Dr. J Thomas Ippoliti **Department or Program Sponsoring Summer Research:** Chemistry Department, Jean Dreyfus Boissevain Lectureship **Home Institution:** University of Saint Thomas **Abstract** Isoluminol derivatives are popular options for tagging molecules in luminescent assays. The purpose of this study is to synthesize a new brighter polymerizable isoluminol derivative that can be used to tag target molecules in assays. In this project the N-methylmaleimide isoluminol precursor containing a polymerizable norbornene ring system, has been successfully synthesized in six steps in but in low yields. This compound has been well characterized with a variety of NMR experiments. The target molecule of this research, an isoluminol derivative, will be synthesized from the N-methylmaleimide precursor by heating with hydrazine in ethanol. The quantum yield of this novel isoluminol derivative will be compared to other known isoluminol compounds.

29.	**Diego F. Gonzalez** *A closer look at the interaction of donor and acceptor molecules in diarylindenotetracene/C60 organic photovoltaic cells.* **Advisor:** Dr. Chris Douglas **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** The University of Texas-Pan American **Abstract** With a new diarylindenotetracene donor material for organic photovoltaic cells synthesized, questions about the interaction of the donor and acceptor layers at the interface level begin to arise. Does the donor layer react with the acceptor layer, and if so, what does this mean for the functionality of the solar cell? Are new compounds formed at the interface? If so, what are the structures? How can we detect it in the solar cell device? Direct and indirect approaches will be examined to characterize and understand the role of any new molecule that may form during device fabrication; as well as to understand the impact they may have on functionality of organic photovoltaic cells fabricated from these promising new materials.
30.	**Ying Hang**, Brynna Jones *The Rate Constant (k) for Oxidative Addition of Oxygen to Chlorocarbonylobis(triphenylphosphine)iridium(I) in a Range of Solvent Mixtures* **Advisor:** Aaron M. Massari **Department or Program Sponsoring Summer Research:** Heisig/Gleysteen Summer Undergraduate Research **Home Institution:** University of Minnesota, Twin Cities **Abstract** Chlorocarbonylobis(triphenylphosphine)iridium(I) is commonly known as Vaska's complex complex and has been used as catalytic model systems for a number of interests. Because Vaska's complex is a catalyst, it can be used to speed up reactions for kinetics and solvent effects studies. In this study, Vaska's complex has been used to study the kinetics of oxidative reactions in a range of solvent mixtures with different concentrations and mole fractions of chloroform and benzyl alcohol. The UV-vis spectroscopy is used to monitor the kinetics of these reactions. Spectra are taken as a function of time to monitor the disappearance of the peaks at a certain wavelength to obtain a pseudo-first order rate constant, which is further used to calculate the second order rate constant for these reactions.
31.	**Bryan Haugen** *The Synthesis of Symmetrical Triazoles* **Advisor:** Dr. Guino-o **Department or Program Sponsoring Summer Research:** University of St. Thomas Chemistry Department **Home Institution:** University of St. Thomas **Abstract** N-heterocyclic carbene ligands (NHCs) have recently attracted much attention due to the fact that NHC-metal complexes are successful catalysts in a number of reactions. The focus on triazolylidenes is especially interesting in the dehydrogenation of ammonia-borane. Ammonia-Borane is a chemical storage for H2, an alternative fuel source. By reacting a triazolylidene with ammonia-borane, H2 is released and is available for fuel use. However, the different triazolylidene ligand affects, such as sterics, on a metal center needs to be examined in order to optimize the dehydrogenation of ammonia-borane. By using a symmetrical triazolylidene (1,2,4-triazole) and systematically varying the size of the substituent's at the N(1) and N(4) position, we hope to determine the optimal size of triazolylidenes to determine the best rate of dehydrogenation for ammonia-borane.
32.	**Matt Hauwiller**, Philip Goff *Photoluminescence and Ultrafast Spectroscopy Studies on Polythiophenes and Polyfluorenes* **Advisor:** David Blank **Department or Program Sponsoring Summer Research:** Heisig/Gleysteen **Home Institution:** University of Minnesota **Abstract** Solar cells are a promising option for generating clean energy due to their ability to convert sunlight to electricity without any harmful byproducts. Much work has been done on organic photovoltaics (OPVs) which are cheaper to make and more maneuverable than traditional Silicon-based solar cells. In this study, new polythiophene and fluorene polymers were tested in an array of experiments investigating their energy conversion properties. UV/Vis and fluorescence spectra were collected to give a background on each polymer series. Quantum yield and fluorescence lifetime measurements give information about the radiative excited state of polymers. Finally, ultrafast spectroscopy was used to probe the energy transfer dynamics of radiative and non-radiative excited states on sub-picosecond time scales.

33.	**Zach Henseler** *Systematic Analysis of Incubation Conditions on G-wire Self-Assembly* **Advisor:** Dr. Thomas C. Marsh **Department or Program Sponsoring Summer Research:** Chemistry **Home Institution:** University of St. Thomas **Abstract** Nanoscale construction has grown dramatically in importance as more possible uses have been determined. Guanine-rich DNA has proven to be a prime candidate for "bottom-up" nanoconstruction, due to the ability of the guanine nucleotide to self-assemble into higher order structures, termed G-wires. Numerous incubation conditions affect G-wire self-assembly, such as temperature and presence of coordinating cation. Loop-length has also been shown to affect supramolecular self-assembly of guanine-rich sequences. However, there has yet to be a systematic analysis of all of these conditions, carried out in order to fully understand their impact of level of self-assembly. Using methods such as PAGE and CD spectropolarimetry, this project aims to gain a better understand of how these factors influence G-wire formation and stability.
34.	**Brenda Her** *A Three Step Synthesis of Benzoyl Peroxide* **Advisor:** James Wollack **Department or Program Sponsoring Summer Research:** Chemistry **Home Institution:** St. Catherine University **Abstract** Benzoyl peroxide is used as a bleaching agent for flour, a polymerization initiator in the synthesis of plastics, and the active component of acne medication (El-Samragy 2004). Because of its wide application, benzoyl peroxide is a target molecule of interest. It can be affordably synthesized in three steps from bromobenzene. The procedure includes the formation of benzoic acid from bromobenzene using the Grignard reaction, then turning the acid into an acid chloride using nucleophilic acyl substitution, and finally synthesizing a peroxide with the addition of hydrogen peroxide. This experiment uses simple techniques and affordable reagents which is suitable for organic chemistry students to perform as a lab. The starting materials for each reaction are commercially available and the products can be characterized using spectroscopic techniques.
35.	**Erin Hill**, Mark Martello *Copolymers of ε-Caprolactone and ε-Decalactone and the Effect of Copolymer Composition on Crystallization.* **Advisor:** Marc Hillmyer **Department or Program Sponsoring Summer Research:** Center for Sustainable Polymers **Home Institution:** University of Minnesota **Abstract** Poly(ε-caprolactone) is used extensively for biomedical device applications as well as for biodegradable engineering polymers. Copolymers of ε-caprolactone and ε-decalactone were prepared by ring-opening polymerization using an array of feed compositions. The copolymerization kinetics at low conversion reveal ε-caprolactone is consumed faster than ε-decalactone. DSC analysis of the copolymers show that both melting temperature and percent crystallinity are reduced with increasing ε-decalactone content and eliminated above 30 mole % ε-decalactone. Copolymers prepared from longer reaction times also showed a reduction in percent crystallinity and melting point. Sequence length distributions of the copolymers were determined using 13C NMR spectroscopy, and show strong evidence of chain reshuffling and randomization of the monomer sequences with increasing time.
36.	**Nezhueyotl Izquierdo**, Yanfei Wu *Scanning Probe Microscopy of Organic Semiconductor Thin Films* **Advisor:** Daniel Frisbie **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Texas Pan-American **Abstract** Organic Thin film Transistors (OTFTs) are emerging as a viable option for creating new and improved electrical products. Organic semiconductors offer low cost and easily processable flexible electronics. The accumulation layer, first few monolayers on top of the gate dielectric, is critical for transistor performance due to the current modulation within these layers. The n-channel organic semiconductor, PTCDI-C8 will be fabricated onto silicon dioxide (SiO2), using thermal evaporation with varying deposition rates and substrate temperatures. Specific microstructure-property relationships in polycrystalline organic semiconductor films of N-channel PTCDI-C8 will be examined using different variants of Atomic Force Microscopy (AFM) including Lateral Force Microscopy (LFM) and Kelvin Probe Force Microscopy (KFM). These scanning probe techniques will help elucidate the structure and electrical transport behavior in organic semiconductors such as electron and hole mobility on molecular structure, crystal packing, intermolecular bonding, and defects in organic crystals and films. Furthermore, research on n-channel organic semiconductors offers the potential of ambipolar OFET that increase the spectrum of available energy potential of transistors applicable in electronics of the future.

37.	**Rachael Jensema** *Simulations of Large Scale Structure Formation; Visualizing Magnetohydrodynamic Turbulence* **Advisor:** Tom Jones **Department or Program Sponsoring Summer Research:** Physics **Home Institution:** Valparaiso University **Abstract** Galaxies have formed due to density fluctuations in the early universe, and have since interacted and merged into large scale dynamic structures called clusters. Simulations of large scale structure formation can provide clues to the physics behind cluster mergers. Most of the ordinary matter in clusters is in the form of hot gas, which is violently stirred into turbulent behaviors during mergers. Turbulence plays a large role in the evolution of the magnetic field which governs many other processes. Finding relationships among these processes gives deeper insight to the physical systems. Visualizations can provide key information to the development of properties concurrently or showing properties that normally go undetected by observers. Using simulations we can hope to further understand the driving force behind the turbulence.
38.	**Lucas Johns**, Tanner Prestegard, Eric Thrane, Vuk Mandic *A gravitational-wave injection study to place upper limits on signal recovery* **Advisor:** Vuk Mandic **Department or Program Sponsoring Summer Research:** School of Physics & Astronomy, University of Minnesota **Home Institution:** Reed College **Abstract** A method is described for placing an upper limit on the distance at which a gravitational-wave (GW) signal can be detected confidently. A simulated waveform is injected into noise and recovered using a GW strain cross-power statistic. The method is presented in the context of an ongoing effort to place limits on the detectability of black hole accretion-disk instabilities.
39.	**Cole Johnson** *Computational Analysis of Molecular Fluoroquinolone using GAMESS* **Advisor:** Joseph Brom **Department or Program Sponsoring Summer Research:** University of St. Thomas Chemistry Department **Home Institution:** University of St. Thomas **Abstract** The electronic structure code GAMESS was used at the Hartree-fock level of theory to compute properties of molecular fluoroquinolone. We are interested in the electronic structure and geometry of the molecule. Various tautomer energies were analyzed, and excited states of the normal lowest energy tautomers and the zwitterion were analyzed. For excited states the DZP+ basis set was utilized and for the ground states DZP was used. The breaking of the C-F bond was observed in the ground state, but the energy level was significantly high. The normal molecule and the zwitterion were solvated and analyzed. Many different dissociative, or bond breaking, excited states were observed. Transitions were labeled and geometries were optimized allowing us insight into the electronic structure of the molecule.
40.	**Jenna Johnson** *Intermolecular Contacts Involving Halogen Atoms in the Solid-State Structures of Some bis-Benzylideneanilines* **Advisor:** William H. Ojala **Department or Program Sponsoring Summer Research:** Department of Chemistry **Home Institution:** University of St. Thomas **Abstract** We define "bridge-flipped isomers" as molecules related by the reversal of a bridge of atoms connecting two major portions of each molecule. Examples occur among the benzylideneanilines, in which the isomerism is Ar-CH=N-Ar' vs. Ar-N=CH-Ar' (Ar = aryl). We are examining benzylideneanilines by single-crystal X-ray diffraction to determine what intermolecular interactions influence the solid-state molecular packing arrangements of these compounds. Here we present the crystal structures of some bis-benzylideneanilines bearing halogen substituents and discuss the intermolecular contacts in which the halogen atoms participate. Our goals are to (1) determine whether these contacts occur over a wide range of structures and (2) determine whether similar contacts occurring in two bridge-flipped isomers can facilitate their assuming the same molecular packing arrangement in the solid state.

41.	**Gaurav Kandlikar**, Mi Yan *Microbial and Chemical characterization of foaming swine manure* **Advisor:** Dr. Bo Hu **Department or Program Sponsoring Summer Research:** UROP **Home Institution:** University of Minnesota, Department of Bioproducts and Biosystems Engineering **Abstract** Over the past few years, swine manure pits around the Midwest have experienced the formation of a thick layer of foam that floats on the manure. The foam traps hydrogen sulfide (a highly poisonous gas) and methane (a highly explosive gas) that are generated in the manure. Exposure to hydrogen sulfide and explosions caused by the ignition of methane gas have caused about 1,500 swine deaths and have resulted in significant property destruction. The research presented herein reports the overall microbial composition of various layers of the manure. Chemical analysis of artificially foaming manure suggests a strong positive correlation between the long chain fatty acid concentrations in the manure and its potential to form a large amount of stable foam.
42.	**Kevin Kelly**, Jaroslaw Nowak *An Estimation of Sensitivities for Neutrino Magnetic Moment Measurement in NOvA Near Detector Data* **Advisor:** Ken Heller **Department or Program Sponsoring Summer Research:** Physics **Home Institution:** University of Notre Dame **Abstract** This study is an attempt to reconstruct and observe magnetic moment interactions in NOvA (NuMI Off-Axis Electron Neutrino Appearance) Near-Detector data and Monte Carlo Samples. These events occur when a single neutrino and electron interact, exchanging helicities, and scatter very cleanly compared to most events in the detector. If, in fact, these interactions exist, the neutrino's magnetic moment can be measured to some accuracy, showing that the neutrino may be a composite particle.
43.	**Lingxun Kong**, Tom Pundsack *Investigating Excited State Dynamics of Poly(3-hexylthiophene)* **Advisor:** David Blank **Department or Program Sponsoring Summer Research:** Heisig/Gleysteen Chemistry Program **Home Institution:** University of Minnesota Twin Cities **Abstract** Organic photovoltaic (OPV) cells are very interesting due to their advantages in cost, ease of fabrication and varied mechanical properties over traditional silicon solar cells. However, the relative low efficiencies prevent the widespread use of OPV cells commercially. To optimize the performance of OPV cells, the excited state dynamics of the light absorber and hole transport material, poly(3-hexylthiophene) (P3HT), were studied. Different percent regioregular P3HT thin films were made using a spin coater. Quantum yields were then measured using fluorescence spectroscopy. Pump-probe spectroscopy was used to measure both radiative and non-radiative exited state dynamics. Differential scanning calorimetry was employed to obtain thermal and structural properties. Comparing the results from optical and thermal experiments, correlations between structure and excited state dynamics of P3HT can be investigated.
44.	**Rebecca Kummer** *Synthesis of a Novel Antibacterial Compound* **Advisor:** Dr. J. Thomas Ippoliti **Department or Program Sponsoring Summer Research:** Chemistry Department **Home Institution:** University of St. Thomas **Abstract** Molecular Topology is a mathematical system that focuses on the interconnectivity between molecules and is able to correlate biological properties to chemical structures. Using this system, it is possible to determine structures of compounds that are not analogous to known active compounds, and therefore have a good chance of being effective against bacteria. The synthesis of a compound predicted by Molecular Topology to have high antibacterial activity has been carried out, along with various derivatives of this compound. The overall synthesis employs a convergent synthetic strategy with at two-step procedure to make each piece. The final step is a reductive amination to yield the final product. The target compound and derivatives will be tested to determine their antibacterial activity against different strains of bacteria.

45.	**Dmitry M. Kuznetsov**, Patrick H. Willoughby *Studies on hexadehydro-Diels–Alder reaction with intermolecular trapping* **Advisor:** Prof. Thomas R. Hoye **Department or Program Sponsoring Summer Research:** Chemistry Lando/NSF **Home Institution:** Higher Chemical College of Russian Academy of Sciences (Moscow, Russia) **Abstract** The Hexadehydro-Diels–Alder (HDDA) reaction is a potentially powerful tool for the synthesis of complex organic molecules. The reaction consists of intramolecular [4+2] cycloaddition of a 1,4-diyne with a tethered alkyne (or diynophile) to a benzyne reactive intermediate. Further benzyne trapping in either an intra- or intermolecular fashion results in polycyclic benzenoids. Synthesis routes to several triyne precursors and subsequent testing of the HDDA reaction with intermolecular trapping agents are presented. Trapping agents were selected based on their potential to give benzene moieties with various heteroatom substituents (oxygen, silicon, sulfur, nitrogen).
46.	**Kayla Lange**, Kaitlin Peterson, Mary Walters, Alexandra Jones, John Dwyer, *Incorporation of Green Chemistry Metrics Into Independent Synthesis Projects* **Advisor:** James Wollack **Department or Program Sponsoring Summer Research:** Chemistry **Home Institution:** St. Catherine University **Abstract** Green chemistry aims to eliminate hazardous substances with less hazardous substances. With reduction of chemical release by humans, ozone depletion, global warming, smog, and water pollution can be decreased. In this curricular study, organic chemistry laboratory students are required to propose their own green alternatives by completing a three-step synthesis in multiple ways and determining the greenest route. To increase the greenness of a reaction, students used alternative solvents and reagents to complete two of the steps of their synthesis. The products were purified, characterized, and compared. A metric system was used to compare the greenness of the reactions. If there were relative decreases in the combination of factors such as cost, environmental factor, yield, and waste produced, the reaction was considered greener.
47.	**Sarah N. Larson** *A Novel Route to N-Alkylated Benzimidazoles* **Advisor:** Dr. J. Thomas Ippoliti **Department or Program Sponsoring Summer Research:** University of St. Thomas Chemistry Department **Home Institution:** University of St. Thomas **Abstract** Benzimidazole derivatives with primary N-alkyl substituents are easily synthesized by first deprotonating a benzimidazole nitrogen and reacting this anion with a primary haloalkane. However, this synthesis yields undesirable elimination products when secondary or tertiary haloalkanes are employed. Benzimidazole derivatives bearing secondary and tertiary alkane substituents have been synthesized in transition metal-catalyzed processes from diazoalkanes, but safety hazards presented by the diazo intermediates make the synthesis unsuitable for large-scale reactions. This study presents a novel synthesis for secondary and tertiary N-alkylated benzimidazoles that is safe and easily scalable. Fluoro-2-nitrobenzene is reacted with a secondary or tertiary amine in a microwave to yield an aminonitro compound that is then reduced to a diamine. The diamine is reacted with triethylorthoformate to give the substituted benzimidazole.
48.	**Jonathan Lee**, Todd Klein *Giant Magnetoresistive Sensors for Biological Applications* **Advisor:** Jian-Ping Wang **Department or Program Sponsoring Summer Research:** NNIN **Home Institution:** University of Central Florida **Abstract** Field-induced domain wall motion through the free magnetic layer of a spin valve nanowire has been observed both electrically and with Bitter Method on scanning electron microscope. The giant magnetoresistance effect is used to determine the position of the domain wall. A series of experiments have been performed with various notch sizes to trap domain walls near the center of the nanowires. Controlled domain wall pinning and depinning is observed for designed notches and fabrication roughness on both 100nm and 200nm wire widths. Change in depinning field strength due to the presence of magnetic nanoparticles (MNPs) in the vicinity of a NiFe nanowire has previously been demonstrated in literature. This work serves as preparation to extend to the sensing of biological molecules tagged with MNPs.

49.	**Luis Malave** *WInd Turbine Control & Emulation with DC Motors* **Advisor:** Ned Mohan, Saurabh Tewarii **Department or Program Sponsoring Summer Research:** Electrical and Computer Engineering **Home Institution:** University of Puerto Rico at Mayaguez **Abstract** Wind energy has exhibited a steady growth in the past decade and continued interest in renewable energy is expected to drive this growth. Efficient control is critical to maximizing the returns from wind farms. This research project develops a testing platform that can emulate wind turbine generation system (WTG) and can be used to test control algorithms for maximum power point tracking (MPPT). This platform is used to emulate an example wind regime and WTG characteristics, and to implement a commonly used MPPT algorithm that does not require wind speed measurement. The research is extended to implement and test a more robust MPPT algorithm proposed in literature that is insensitive to variations in air density.
50.	**Darren Mareskas-Palcek**, *Multi-Variable Analysis in Particle Identicifation* **Advisor:** Daniel Cronin-Hennessy / Alex Kamenev **Department or Program Sponsoring Summer Research:** NSF/ UMN Physics **Home Institution:** Eckerd College **Abstract** We examine different methodes of multi-variable analysis, specifically artificial neural networks, boosted decision trees and log likelihoods using a program called TMVA to determine which method has more power in particle identification on simulated Monte Carlo events of electron neutrino interactions, like the ones that will take place in the NOvA experiment. Beyond examining the different methods we also identify which variables have the most impact on our results and will possibly introduce new variables in an attempt to improve our particle identification software even more. The overall goal of this research is to improve particle identification techniques that will be used in the NOvA experiment.
51.	**Rebecca McAuliffe** *Consequences of Bose-Einstein Condensation in Superfluid 4He* **Advisor:** J. Woods Halley **Department or Program Sponsoring Summer Research:** Physics **Home Institution:** Marquette Univerisity **Abstract** Running experiments in which pulse of helium vapor are directed at a thin film of superfluid helium. Looking at the response of the superfluid film by detecting pulses with superconducting titanium bolometers on the opposite side of the film. We are looking at the phonon mediated transimissions within the films and searching to see the roton transmission by using an optical source to send a higher energy pulse.
52.	**Alec Nicol**, A. Mahjoub, M. Kida, N. Aoki, J. P. Bird, D. K. Ferry, K. Ishibashi, and Y. Ochiai *Development of a Graphene Field Effect Transistor for GHz/THz Sensing* **Advisor:** Yuichi Ochiai **Department or Program Sponsoring Summer Research:** NanoJapan Summer Research Program **Home Institution:** University of Minnesota-Twin Cities **Abstract** A small forbidden gap matched to low energy photons (meV) and a quasi-Dirac electron system are both definitive characteristics of bilayer graphene that has gained it considerable interest in realizing a broadly tunable sensor for application in the microwave (GHz) to terahertz (THz) regimes. This is due to the unique phase coherent length of open quantum-dot structures formed in graphene when exposed to GHz/THz radiation. Existing GR-FETs have shown excellent photoresponse around 10 GHz and are predicted to have continued sensitivity in the THz range after the measurement setup is optimized. Herein, improvements to the wiring setup, sample box architecture, graphite source, and bolometric heating of the GR-FET sensor were made in order to extend microwave photoresponse to 40 GHz and further improve THz detection.

53.	**Tim O'Brien** *Non-linear least squares fitting for Faraday rotation of astrophysical polarized signals* **Advisor:** Lawrence Rudnick **Department or Program Sponsoring Summer Research:** REU in Physics and Astronomy at the University of Minnesota **Home Institution:** University of Notre Dame **Abstract** The Rotation Measure (RM) is an empirical quantity used in determining magnetic field and particle density structure of the Intracluster Medium (ICM) in galaxy clusters. It expresses the relationship between the observed angle and the observing wavelength of polarized synchrotron emission. However, measurement of the RM can be complicated due to the possibility of multiple radio emitting regions and distinct Faraday rotating regions along the same line of sight. Here we explore a possible alternative to the Rotation Measure Synthesis technique proposed by Brentjens & de Bruyn (2005) which utilizes a non-linear least squares fit on polarization data using a two RM component model.
54.	**Zachary Oberholtzer**, Aaron Hedegaard *Rheological Behavior of Branched Poly (lactic acid)* **Advisor:** Chris Macosko **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Bucknell University **Abstract** Poly (lactic acid) (PLA) is produced from renewable resources and is one of the first commercially produced biodegradable polymers. It is therefore desirable to adapt PLA to applications traditionally dominated by petroleum based products such as food packaging. Until recently PLA could not be used in foaming processes due to its low extensional viscosity. High extensional viscosity is necessary to prevent cell coalescence and collapse during foam processing, however, if the extensional viscosity is too high processing becomes difficult. Branched and chain extended PLA has been produced in an attempt to improve the rheological properties of the material. The focus of this project is characterizing the rheology of the branched and chain extended structures to determine their viscoelastic properties and suitability for foaming processes. The characterization of these properties will be carried out using shear and capillary rheometry.
55.	**Stephen A Olson**, Nathan C Lindquist, Sudhir Cherukulappurath, Timothy W johnson, Jincy Jose, Xiaoshu Chen, Luke R. Jordan and Sang-Hyun Oh *Fabrication of metallic structures and their applications in surface plasmon resonance sensing* **Advisor:** Sang-Hyun Oh **Department or Program Sponsoring Summer Research:** NSF, NNIN, ECE-UMN **Home Institution:** Bethel University **Abstract** Optical energy can be harnessed on the nanoscale by exploiting plasmonic resonances in metallic nanostructures. These resonances are the result of the unique optical properties of metals and their abundance of conduction electrons. Utilizing these properties, it is possible to engineer metallic nano-devices that operate with large electric field intensities confined in and around the structure. Due to these large fields, optical, chemical and spectroscopic properties can be probed with high sensitivity. This project covers the various fabrication methods unique to the precise fabrication of metallic nano-structures as well as some applications as nano-optical sensors.
56.	**Sean Pickthorn**, Intaek Lee, Tessie Panthani *Synthesis of Poly(lactide-b-butadiene) Multiblock Copolymers* **Advisor:** Frank Bates **Department or Program Sponsoring Summer Research:** Center for Sustainable Polymers **Home Institution:** St. John's University **Abstract** To improve the brittle behavior of polylactide, preparation of polylactide-b-polybutadiene-b-polylactide multiblock copolymers were synthesized with a fixed weight of dihydroxyl polybutadiene (~3000 and ~2000g/mole series) and variable volume percent (50-90%) of both semicrystalline poly(L-lactide) and amorphous poly(D,L-lactide). Initially, triblock polymers were catalyzed with a ring opening polymerization and characterized. Toluene diisocyanate (TDI) and terephtaloyl chloride (TCL) were used to couple the triblock copolymers to form multiblock structures. Characterization of these products was accomplished by differential scanning calorimetry, small angle X-ray scattering, 1H-NMR spectroscopy, size exclusion chromatography, dynamic mechanical analysis, and tensile testing, leading to an extensive set of thermal and mechanical properties of both the triblock and multiblock copolymers. Collectively, these results will allow selective synthesis to help achieve toughened biorenewable multiblock copolymers.

57.	**Rashmi Poudel** *On-line trapping and desorption for the improvement of nitric oxide detection with micro-dialysis extraction and a chemiluminescence detector.* **Advisor:** Tony Borgerding **Department or Program Sponsoring Summer Research:** URC **Home Institution:** University of Saint Thomas **Abstract** Nitric oxide (NO) is a neurotransmitter found in the human brain that plays an important role in cellular communication in the central nervous system. We had success with rapid extraction and detection of NO using microdialysis membranes and chemiluminescence detection (CLD).Our goal is to improve the sensitivity and near-real time measurement of NO concentration using on-line trapping and desorption. The current detection limit without trapping is approximately 5μM. We used two different sorbents: porous graphite and PLOT column. These sorbents are held inside a 1/16" silcosteel tube which is rapidly heated with a current pulse for rapid thermal desorption. After desorption of analyte trapped inside the PLOT column, signal increased by five times compared to the signal obtained by using microdialysis membranes only.
58.	**M. Alex Radtke**, Dr. Kriti Srivastava, Katie Peterson *Towards the Synthesis of a Calcium-Selective 19F MRI Contrast Agent* **Advisor:** Dr. Valerie Pierre **Department or Program Sponsoring Summer Research:** Lando **Home Institution:** University of British Columbia **Abstract** Calcium is an important intracellular messenger. Calcium can modulate cellular metabolism and is used in cellular signaling and regulation. Previously, calcium-selective fluorescent probes were used to elucidate calcium's role in these processes. However, depth penetration is limited by light scattering to surface cells. Magnetic resonance imaging overcomes this drawback, and gadolinium-based contrast agents which increase the relaxivity of water in the presence of calcium have been developed. There have been reports of fluorinated chelators in which the binding of metal ions can be monitored by 19F-NMR. These can identify multiple ions based on the NMR shifts of the fluorine. Following this, we aim to develop a sensitive, calcium-selective probe for in vivo monitoring of the ion through time and space using fluorine magnetic resonance.
59.	**Maritza Reyna**, Ryan Knutson *Hydrophilic Stability and Dispersion of Mix-metal Sulfide Nanoparticles through Ligand Exchange* **Advisor:** Prof. R Lee Penn **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Puerto Rico at Humacao **Abstract** The conversion of hydrophobic nanoparticles into a water dispersible state is of great importance and generates active interest of researchers throughout the world. Ligand exchange to convert nanoparticles from hydrophobic to hydrophilic improves stability and dispersibility in water. Exchanging a BULKY ligand with a smaller one helps to decrease the separation distance between particles and, thus, increase the interparticle conductivity. Methods like dynamic light scattering (DLS), and Ultra-violet Visible light (UV-Vis) spectroscopy will be employed to characterize ligand-exchanged nanoparticles. In particular, the band gap, the dispersion state, the average size of aggregates and primary nanoparticles will be quantified. Finally, Attenuated Total Reflectance- Fourier Transform Infrared Spectroscopy (ATR-FTIR) analysis will be used to detect the surface-bound ligands before and after ligand-exchange, respectively.
60.	**Ruben Reyna**, Jeslin Wu *UV-Stable Silicon Nanocrystals to Enhance Solar Cell Efficiencies* **Advisor:** Prof. Uwe Kortshagen **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Texas-Pan American **Abstract** Silicon nanocrystals possess an indirect band gap that has the potential to enhance photovoltaic (PV) efficiencies through luminescent downshifting. The nanocrystals absorb high-energy photons that are ineffectively utilized by the solar cells and downshifts them into low energy photons, which can then be efficiently converted into charge carriers by the cell. Nanocrystals with high conversion efficiencies, or photoluminescent quantum yields, are produced in non-thermal plasma. Through a post-synthesis thermal hydrosilylation process, alkenes are attached onto the nanocrystals' surface, which decreases surface defects and allows effective electron-hole recombination. Quantum yields of over 60% have been achieved; however, the conversion efficiencies of these nanocrystals degrade with exposure to UV light. To overcome this effect, a photochemical hydrosilylation process is proposed in lieu of the thermal hydrosilylation process.

61.	**Gabriel Rueda** *Simulated TEM imaging of modified Zeolite structures* **Advisor:** K. Andre Mkhoyan **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Texas Pan American **Abstract** I am studying zeolite structures modified to incorporate substitute atoms for novel catalytic applications. The modified zeolite structures will perform a particular task when encountered by a molecule diffusing through a substitute-functionalized pore, such as breaking down the molecule that has come into contact with the substitute atom (Ti or Sn). My specific job during this study is running computer simulations of bright-field conventional transmission electron microscopy (BF-CTEM) and annular-dark-field scanning transmission electron microscopy (ADF-STEM) to make sure that we can identify and locate catalytically active substitute atoms within the zeolite structure.
62.	**Amber Schoenecker** *The characterization and study of glycosaminoglycan interactions with Tat peptide to aid in drug delivery* **Advisor:** Dr. Lisa Prevette **Department or Program Sponsoring Summer Research:** Department of Chemistry **Home Institution:** University of St. Thomas **Abstract** The interactions between cell-penetrating compounds (CPCs), positively charged molecules that can cross cell membranes, and certain cell receptors are not well understood but could aid drug design and development. The goal of this study was to compare binding thermodynamics between the CPC trans-activating transcription factor (TAT) peptide, and four negatively charged, linear polysaccharides known as glycosaminoglycans (GAGs). The different GAGS that were studied exist to different extents on different cell types. Using isothermal titration calorimetry (ITC), the association constant (Ka), enthalpy (ΔH), and stoichiometry (n) of each interaction was determined. Because the GAGs were harvested from a biological source and are therefore polydisperse, characterization by nuclear magnetic resonance (NMR) spectroscopy, liquid chromatography- mass spectrometry (LC-MS), colorimetric assay and gel-permeation chromatography (GPC) is being carried out.
63.	**Mark Schwerkoske** *Synthesis of Potential Antimalarial Compounds* **Advisor:** Dr. J.T. Ippoliti **Department or Program Sponsoring Summer Research:** Department of Chemistry **Home Institution:** University of St. Thomas **Abstract** It has been found that certain quaternary ammonium salts play an active role inhibiting the growth of the Plasmodium falciparum parasite, more commonly known as malaria. Through the years the parasite has gained resistance to traditional medications. Variations of quaternary ammonium compounds have shown potent antimalarial properties and have gained attention as a viable new, effective, and relatively cheap malaria treatment. Quaternary ammonium compounds that have a cholesterol moiety attached are not known. A series of 1-bromo carboxylic acids were coupled with cholesterol, and the resulting esters reacted with various diamines and amines to form the desired diquaternary and quaternary ammonium salts. These compounds are awaiting formal testing of their antimalarial properties and could prove to be a new and much needed malaria treatment.
64.	**Sammy Shaker[1]**, Michael Vella[2], Maxwell Shinn[1] *The influence of network motifs on network dynamics and bistability* **Advisor:** Duane Nykamp **Department or Program Sponsoring Summer Research:** Mathematics **Home Institution:** [1] - University of Minnesota [2] - University of Notre Dame **Abstract** Computations in the brain are performed via complex networks of neurons. Yet, the impact of this network structure on network dynamics remains virtually unexplored. Certain connectivity motifs appear more frequently in the brain than predicted by standard random network models (Song et al., 2005). The frequencies of the chain motifs have a dramatic effect on network dynamics. They can increase the dimension of the dynamics, lead to bistability (via a saddle node bifurcation) in an EI network without EE conections, and can modulate the level of synchrony (via a Hopf bifurcation). This has implications in understanding the neural correlates of working memory and epilepsy.

65.	**Rifat Sheikh** *Doping of Germanium with Antimony* **Advisor:** Dr. Joseph Talghader **Department or Program Sponsoring Summer Research:** Electrical and Computer Engineering, University of Minnesota, Twin Cities and NSF **Home Institution:** Lawrence Technological University **Abstract** My research involved optimizing absorption of Germanium films doped with Antimony. The application of the device is to detect gases that have narrow band IR absorption ranging from 8μm to 12μm. The device has an optical cavity that ensures that only certain wavelengths resonate through the film and get absorbed by the doped Germanium film. Films were created by sputtering Germanium with Antimony as the dopant. Films were annealed at different conditions to get an approximation of a condition that gives maximum absorbance. Absorption depends on free carriers and measuring free carrier optically is difficult. So we measured the conductance of the films to get an estimate of the number of free carriers in the films. Van der Pauw measurements were used to measure conductance.
66.	**Ross Siegel**, JJ Nelson *Experimental Methods in Condensed Matter Physics* **Advisor:** Allen Goldman **Department or Program Sponsoring Summer Research:** Physics & Astronomy **Home Institution:** Northern Arizona University **Abstract** Crystals such as herbertsmithite and strontium iridate have not had their electrical properties measured. Their lattice structures suggest the possibility of superconductivity. These crystals are difficult to produce and are smaller the 1x1 mm and a method of placing these crystals inside over exposed SU-8 negative photo resist for photo lithography metal patterning is being investigated.
67.	**Allison Siehr**, Isha Koonar *Living Polymerization and Characterization of AB and ABC Block Polymers* **Advisor:** Ron Siegel **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Texas-Pan American **Abstract** Stimuli-responsive block polymers can assemble into different morphologies depending on, firstly, their composition and number of the blocks and, secondly, the environmental stimulus. For example, AB diblock and ABC triblock polymer solutions can form micelles or hydrogels, respectively. These structures are of increasing importance in biomaterials and drug delivery applications. In the present work, micellization and gelation of block polymers composed of poly(N-isopropylacrylamide), poly(N-isopropylacrylamide-co-acrylic acid), and poly(N,N-diethylacrylamide), are being studied as a function of temperature and pH. The block polymers, synthesized using RAFT living polymerization, are characterized using matrix-assisted laser desorption ionization mass spectrometry, 1H-NMR, and potentiometric titration to determine block polymer molecular weight, composition, and structure. Phase behaviors, including micellization and gelation, are characterized by UV-spectrophotometry, dynamic light scattering, and dynamic rheological/mechanical testing.
68.	**Caroline Sileo**, Chad Geppert, Ryan Marshall *Low Temperature Annealing of Non-ferromagnetic Contacts on GaAs* **Advisor:** Paul Crowell **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** University of Florida **Abstract** The measurement of spin transport in semiconducting materials depends on a heavily doped Schottky barrier contact. To reduce noise when taking measurements, there is a need for both ferromagnetic and nonferromagnetic contacts on the same device. The goal is to create such a device using low temperature annealing methods, and determining which annealing method results in the least noise when the contact is used as a voltage probe. Layers of nickel, germanium, and gold are deposited on to a GaAs/FeAlAu wafer and etched away to create contacts. The non-ferromagnetic contacts will be annealed by either exposure to a laser, or local application of high current. Measurements of these contacts will be taken to determine which annealing method results in the best contact.

69.	**Kayla Simmion**, Tyler Mullenbach *Investigating a relationship between exciton decay rates of Rubrene and Methyl Rubrene and their molecular behavior* **Advisor:** Dr. Russell Holmes **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Florida A&M University **Abstract** Because of the properties of organic semiconducting molecules, they are widely used in manufacturing organic photovoltaic (OPV) cells. Theses properties make exciton diffusion for dissociation of excitons into charge carriers ideal. Exciton diffusion in many OPV cells occurs via Förster energy transfer. Increasing exciton diffusion will enhance the photoluminescence efficiency (ηPL) of OPV materials. Functionalization, a method used in increasing exciton diffusion, changes both intermolecular and intramolecular interactions. Researching the effects of functionalization on ηPL and exciton lifetime using Rubrene and its derivative, Methyl Rubrene, a connection between their exciton decay rates and molecular behavior was hoped to be determined through literature search. Unfortunately, little is known about this relationship. In future work, I suggest more research on molecular activities being affected by exciton decay.
70.	**Michael Slitts** *Ni(NHC)2 Complexes For Use In The Catalytic Dehydrogenation of Ammonia Borane* **Advisor:** Dr. Marites A. Guino-o **Department or Program Sponsoring Summer Research:** University of St. Thomas Young Scholars Program **Home Institution:** University of St. Thomas **Abstract** Due to their effectiveness and integral role in the catalytic dehydrogenation of ammonia borane, we seek to investigate triazole based N-heterocyclic carbene (NHC) nickel metal complexes more thoroughly. We have synthesized a family of these carbenes with varying electronic properties, as well as steric properties, via optimized microwave reactions. The NHC's were coordinated with nickel to form Ni(NHC)(CO)3. Through infrared spectroscopy, we are investigating the electronic effects of the NHC ligand on the CO stretch frequencies. The sterics of our ligands will be characterized through single crystal x-ray diffraction and the percent volume buried model.
71.	**Brandon Taitt** *Gold Nanocluster and Tetrakis(3-chlorophenyl)borate Films on 3DOM Carbon as an Effective Solid Contact in Ion-Selective Electrodes* **Advisor:** Philippe Buhlmann **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Carleton College **Abstract** The cost-effective fabrication, durability, maintenance-free operation, and high analytical performance of solid contact ion-selective electrodes (SC-ISEs) make them the most promising generation of potentiometric ion sensors to date. Tetrakis(3-chlorophenyl)borate (TB-) anion doped films on solid contacts (SCs) have been shown to perform well when faced with most of the signal stability problems of SC-ISEs. Furthermore, monolayer-protected Au clusters (MPCs) have proven to be particularly capable SC transducersã€" yielding low potential drift and stable and reproducible linear range, sensitivity, and standard potential. We synthesized MPC and TB- films and integrated them into three-dimensionally ordered macroporous (3DOM) carbon platforms, which have been shown to exhibit excellent long-term stabilities and good resistance to interferences from oxygen and light in SC-ISEs.
72.	**Meghan Talbot** *Synthesis of Triazolylidene Type Ligands* **Advisor:** Dr. Tess Guino-o **Department or Program Sponsoring Summer Research:** University of St. Thomas Work Study **Home Institution:** University of St. Thomas **Abstract** The process of dehydrogenation is an effective way to produce hydrogen fuel. As proven by Baker's group, pairing the triazolylidene ligand (TPT) to a nickel center acts as an effective catalyst for the dehydrogenation of ammonia-borane. We sought to effectively reproduce the synthesis of this ligand through following the literature presented by Ender and his team. By following this procedure, the ligand's precursor N-phenylbenzamide phenylhydrazone must first be produced before the ligand can be correctly synthesized. This precursor has been prepared from benzoyl chloride, aniline, phenylhydrazine, and triethylamine. Using a two-step microwave synthesis, the reaction for the triazolylidene ligand's precursor, N-phenlybenzamide phenylhydrazone, has been successfully optimized. Future plans include the production of the TPT ligand and the optimization of this synthesis.

73.	**Michael Thiem** *Quantitative Measurement of an Ultra Small Riboflavin Fluorescent Sample Using a Titration Method* **Advisor:** Gary Mabbott **Department or Program Sponsoring Summer Research:** UST Chemistry Department **Home Institution:** University of St. Thomas **Abstract** The scientific community is pushing the frontiers of chemical analysis into the ultra-small (sub nanoliter) samples. The goal of this project is to develop a highly accurate and precise method of measurement based on fluorescence titration of the ultra-small samples. Riboflavin is an intensely fluorescent compound that has its fluorescence quenched when it associates with a riboflavin binding protein (RBP), isolated from egg white. This system has been used to characterize the vitamin riboflavin in a wide variety of food and beverages. The titration methodology proved to work on a milliliter scale using a conventional spectrofluorometer (FluoroMax Spex). Our current experiment is the measurement of an ultra-small riboflavin sample using a microscope Liquid Crystal Tunable Filter Spectrophotometer.
74.	**Nam Tran**, Benjamin Wilson *Synthesis and Characterization of Nanostructured Carbon Electrodes for Electric Double-Layer Capacitors* **Advisor:** Andreas Stein **Department or Program Sponsoring Summer Research:** Department of Chemistry and LANDO/NSF program **Home Institution:** University of Texas at Arlington **Abstract** Electric Double-Layer Capacitors (EDLCs), also known as supercapacitors, are widely used in electronic devices, automotives, and weatherproof power sources due to their high power density and long life spans.[1] Supercapacitors store charge on the surface of an electrode, commonly made of mesoporous carbon (pore size between 2-50 nm). We have synthesized carbon electrodes with various pore sizes via hydrothermal synthesis or evaporation-induced self-assembly with commercially available Pluronic F127 triblock copolymers. The pore structure of the carbon material was determined with small angle X-ray scattering and nitrogen sorption. The galvanostatic charge/discharge measurements using a symmetric two-electrode cell and ionic liquid electrolyte showed that the capacitance increased from 1.8 to 8.5 F/g as the pore diameter increased from 1.8 to 4.2 nm. The result indicated the pore size dependence of the capacitance. Future work will focus initially on the synthesis of ultra-large-pore mesoporous carbons with controlled pore size using poly(styrene)-poly(ethylene oxide) diblock copolymers.
75.	**Michelle Victoria** *Programming Android Applications* **Advisor:** Anand Tripathi **Department or Program Sponsoring Summer Research:** ECE REU **Home Institution:** Massachusetts Institute of Technology **Abstract** his summer, my main goal was to create an application that combined GPS-based and online map services with media files to create a walking tour of the UMN campus, complete with a route tracer and address-book to display names of various buildings when in proximity. Side-objectives included becoming familiar with using threads off the main user-interface thread, learning about services and intent-based communication, and experimenting with dynamic user interfaces. Future goals to this project include improving my walking tour program to respond better to proximity alerts. I'd also like to create an application that incorporates the sensors of the phone with the photo-taking service in order to produce an application that provides the user with a realistic 3D-image of an object in the real world.
76.	**Geoffrey Vria** *High Fidelity Method for Microfabricating In Vitro Neural Networks* **Advisor:** Patrick Alford **Department or Program Sponsoring Summer Research:** National Nanotechnology Infrastructure Network **Home Institution:** Middlebury College **Abstract** Functional in vitro neural networks are essential for uncovering the underlying cellular mechanisms by which mechanical stress induces traumatic brain injury; however, current methods for fabricating cell networks are unable to replicate the complexity and organization of the brain. Here, we propose a novel fabrication technique that incorporates a microfluidic device to capture cells in an organized array, placing them in contact with a micropatterned substrate. As proof of concept, we used 3T3 fibroblasts to assess the efficiency of this technique. Compared to standard microcontact printing, microfluidic delivery of cells resulted in more consistent, uniform adherence to patterned substrates. This technique can be employed to develop more complex in vitro models to better understand how cellular dysfunction is transmitted between distant regions of the brain.

77.	**Dylan Walsh**, Zhongda Pan *Palladium-Catalyzed C-CN Activation* **Advisor:** Chris Douglas **Department or Program Sponsoring Summer Research:** Heisig/Gleysteen Summer Undergraduate Research Fellows **Home Institution:** U of Minnesota **Abstract** The activation of carbon-carbon bonds is an emerging and important research topic in organic chemistry. The rearrangement of molecules at the carbon-carbon bond level has been achieved with the use of palladium and phosphoramidite ligands to produce high yields and high enantiomer selectivity. New research was conducted to further the development of intramolecular asymmetric alkene cyanoamidation which proceeds through carbon-carbon bond activation by taking on a more challenging starting material, which then required new conditions. A library of phosphoramidite ligands was synthesized containing more the 36 compounds, as well as several different solvents were tested at multiple different temperatures. As of this moment, yields of nearly 99% and enantiomer selectivity of 68% have been produced.
78.	**Ella Wassweiler** *Exfoliation of Graphene From Silicon Carbide* **Advisor:** Prof. Philip Cohen **Department or Program Sponsoring Summer Research:** Electrical and Computer Engineering REU **Home Institution:** University of Iowa **Abstract** This summer my project was to develop a new way to exfoliate graphene from silicon carbide. Graphene is a single sheet of carbon atoms that can be grown from silicon carbide using heat in a vacuum. Ideas for this exfoliation include using an electrostatic force or using a strong adhesive. With unique electrical properties graphene is thought to be a suitable material for next generation electronics. One of the next steps in studying graphene is to look at how to control these electrical properties using impurities. The unique growth of graphene on silicon carbide is thought to make the addition of impurities easier. A new, reliable exfoliation technique then is needed in order to be able to study the individual graphene once it has been grown and experimented with on the silicon carbide. The hope is to exfoliate the graphene from silicon carbide and on to a transmission electron microscope grid so that we can pinpoint the exact location of impurities when studying a sample's electrical properties.
79.	**Jonathon Watson**, Dr. Tim Anglin *Interfacial Spectroscopy of Organic Electronics* **Advisor:** Professor Aaron Massari **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Xavier University of Louisiana **Abstract** Poly(3-hexylthiophene), P3HT, has long been studied because of its ability to conduct electricity with a primary focus on applications in organic electronics and solar energy. Though years of research has provided fundamental knowledge on the system, many unknowns remain. In particular, little is understood about what occurs electronically at the boundary the polymer would share with other materials. In this project, P3HT will be prepared as uniform thin films on appropriate substrates via spin-coating, and the characteristics of the interfaces will be measured through spectroscopy. Films of varying thicknesses will be characterized by ellipsometry and UV-visible spectroscopy to extrapolate to the electronic absorption spectrum of the interfacial regions. Then, second harmonic generation will be used to directly measure the electronic spectrum of the interfacial P3HT molecules.
80.	**Daphne Welter** *Online Monitoring of Fermentations Using Microdialysis Extractions Coupled with Mass Spectrometry* **Advisor:** Tony Borgerding **Department or Program Sponsoring Summer Research:** URC **Home Institution:** University of St. Thomas **Abstract** Microdialysis is an effective sampling method for monitoring volatile analytes in aqueous solutions, but extraction efficiency is low. I focused on coupling microdialysis extractions with mass spectrometry in order to improve the detection limits of this technology and expand its applications. I have interfaced microdialysis probes with several mass spectrometry techniques, including atmospheric pressure chemical ionization, extractive electrospray ionization, and proton transfer reaction mass spectrometry. Testing has shown that all three techniques have improved detection limits over a GC system. I am monitoring wine fermentations to affirm the online monitoring capabilities of these techniques. I have observed the signal due to m/z 47.07 (protonated formula mass of ethanol) rising over time, as well as several other masses from compounds I have not yet identified.

81.	**Greg Whelan** *Switched Capacitor DC-DC Converters* **Advisor:** Dr. Chris Kim **Department or Program Sponsoring Summer Research:** ECE REU **Home Institution:** Trine University **Abstract** As electrical devices become smaller and increasingly portable, a smaller and more efficient dc-dc voltage converter is required. A standard voltage convert includes components that are not compatible with the inherent size constraints and exhibit effects that could alter the intended output. A switched capacitor dc-dc converter offers a robust solution, allowing direct integration within an integrated circuit and removing unwanted off-circuit signal noise. The component effects of off-circuit power supplies are removed using only capacitors and transistors. The invention of deep trench capacitors greatly improved the size and capacitance values required for an efficient convert. My project centered on the resulting power efficiency and power density of a switched capacitor dc-dc converter, values relating to the converter's area efficiency and a devices battery life.
82.	**Christian White**, Roger Giovannagelli *Fabrication and Analysis of a MRI Contrast agent for Cu(I)* **Advisor:** Prof. Valerie Pierre **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Xavier Univeristy of Louisiana **Abstract** Research has shown that there is an increase in Cu(I) in the brain in the presence of neurological diseases; therefore, by using Cu(I) to aggregate the ligand attached magnetite together, the local relaxivity increases. MRI needs a contrast agent because it lacks spatial resolution. Magnetite nanoparticles have been under study due to their magnetic characteristics. This study will investigate the induced aggregation of magnetite via Cu(I). Dop-PEG-N3 and Dop-PEG-C≡CH are the ligands synthesized. Once synthesized, Fe3O4 will be attached to each ligand. Then Fe3O4@Dop-PEG-N3 and Fe3O4@Dop-PEG-C≡CH will be "clicked" together using Cu(I)-catalyzed Huisgen cycloadditions. These particles will be characterized using TEM which measures the size of the nanoparticles, relaxivity shows how the particles respond to magnetism, and XRD verifies the chemical composition of the nanoparticles.
83.	**Matthew Worth**, Kenneth Tritch *Cyclizative Condensations of Indole and Cyclic Ketones* **Advisor:** Dr. Wayland Noland **Department or Program Sponsoring Summer Research:** Lando Summer Research Program **Home Institution:** The College of Wooster **Abstract** Cyclizative condensations of indole and ketones (CCIK's) is a ring-forming reaction whose products can potentially have biological activity against diseases. Although a variety of ketones have been used in CCIK reactions, CCIK products have not yet been isolated using cyclic ketones. In this study, cyclopentanone, cyclohexanone, cycloheptanone, cyclooctanone, cycloundecanone and cyclododecanone were each reacted with indole in an attempt to produce novel CCIK compounds. Adding indole slowly to cyclopentanone at 0 C, followed by heating at 50 C for one day yielded one major product. Reaction of indole with cyclododecanone proceeded similarly to cyclopentanone as seen with TLC monitoring, while progress has been made with other ring sizes as well.
84.	**Olga Zamulko** *Synthesis of Topologically Designed Novel Antibiotic* **Advisor:** Dr. J. Thomas Ippoliti **Department or Program Sponsoring Summer Research:** Medisyn Technologies Inc. **Home Institution:** University of Saint Thomas **Abstract** Numerous bacterial strains have become immune to the currently available drugs. Thus, the need for synthesis of novel antibiotics that are designed to combat multi-drug resistant bacteria is imperative. Recently, the use of Molecular Topology (MT) has been implemented to construct uniquely structured chemical compounds. This revolutionary technology correlates chemical structure to molecular activity to design theoretical compounds with very high antibacterial properties. The research performed this summer utilized a five-step synthetic route to develop a drug that Medisyn Technologies Inc. predicted to have an 85% chance of being an effective antibiotic. Each intermediate in the synthesis was purified and characterized. The new antibiotic was tested for potency against the bacterial strains Staphylococcus aureus and Escherichia coli.

85.	**Joy Zhou**, Dr. Christopher J. Douglas *Synthesis of 5,6,11,12-Di-o-phenylenenaphthacene via Palladium-Catalyzed Cross Coupling* **Advisor:** Dr. Christopher J. Douglas **Department or Program Sponsoring Summer Research:** Heisig/Gleysteen Chemistry Program **Home Institution:** University of Minnesota - Twin Cities **Abstract** Organic electronic devices, in particular photovoltaic cells, have become an increasingly popular research topic due to the prevalent energy crisis caused by the dependency on fossil fuels. These photovoltaic cells are comprised of semiconducting materials, used to convert solar energy to electricity. Organic semiconductors (OSC) have since made headway and are applauded for their lightweight and flexible properties, as well as their economic efficiency. The formulation of 5,6,11,12-di-o-phenylenenaphthacene, a tetracene derivative, was attempted via new palladium-catalyzed synthetic routes to be used as a high performance OSC due to its heavy conjugation, symmetrical nature, and unique and rare optical properties. Suzuki-Miyaura cross coupling and Hiyama-Denmark cross coupling conditions were performed between 5,6,11,12-tetrachlorotetracene and 1,2-diborylbenzene and benzobisoxadisilole, respectively.

Poster Presentations by RET Participants
Listed Alphabetically by Presenting Author

86.	**David Miller** *Molecular Beam Epitaxy* **Advisor:** Bharat Jalan **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** **Abstract** Molecular beam epitaxy (MBE) is a method of depositing single crystals. MBE is widely used in the manufacture of semiconductor devices, including transistors for cellular phones and WiFi. Recently, the world's most efficient solar cells have been demonstrated with MBE and are being commercialized.
87.	**Leonardo Santiago,** David Rowe *Bringing Materials Science Research into the Middle School Classroom* **Advisor:** Uwe Kortshagen **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Aurora Charter School **Abstract** Semiconductor nanocrystals have attracted considerable interest for a wide range of applications including light-emitting devices and displays, photovoltaic cells, nanoelectronic circuit elements, thermoelectric energy generation and luminescent markers in biomedicine. Nanostructured materials research will contribute significantly to potential advances in next generation photovoltaics through development of new architecture for the design of highly efficient solar cells. In recent years, silicon nanocrystals (SiNCs) have become an attractive material for opto-electronic devices due to their unique properties which set them apart from their bulk material counterpart. This is my first summer working with materials science research. As a middle school teacher, I am interested in the development of analogies that challenge my students with some of the same issues that materials scientists do, while still working at an appropriate developmental level. One way to do that is using the Parallel Task approach. In this research experience I've been studying that gas-phase impaction of plasma-synthesized doped SiNCs has potential as an efficient method for depositing the n-type emitter layer for np junction solar cells.
88.	**Claire Hypolite** *Simple and Robust Engineering Projects for High School* **Advisor:** Kevin Dorfman **Department or Program Sponsoring Summer Research:** MRSEC **Home Institution:** Minneapolis Edison High School **Abstract** This continued effort to provide low cost, but robust, engineering activities for high schools focuses on a stirred tank. Using modified building toys, students can design different impeller systems and compare their designs with others through dimensionless numbers such as the Reynold's and Power Numbers. This project allows students to investigate how material properties affect engineering design, and is simple way for teachers to implement the new Minnesota engineering standards into their lessons.