UNIVERSITY of WASHINGTON

Undergraduate Research Symposium May 16, 2014 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons East, Easel 70

11:00 AM to 1:00 PM

Investigation of Preservative Agents to Enhance Poliovirus Survival on Virocap Filters

Kilala Barnes, Senior, Environmental Health
Mentor: Christine Fagnant, Environmental & Occupational Health Sciences
Mentor: John Scott Meschke, Environmental & Occupational Health Sciences

Poliovirus (PV) remains endemic in three countries and is responsible for sporadic outbreaks in several others. Clinical surveillance for acute flaccid paralysis (AFP) is the gold standard for PV surveillance. However, as few as 1 in 100 to 1 in 1000 PV infections will develop AFP, particularly in well-vaccinated populations. Environmental surveillance of wastewater using a bag-mediated filtration system is currently being investigated to detect sub-clinical circulation of poliovirus. However, the filter samples will be collected remotely and evaluated centrally, which requires a shipping period. During this shipping period, bacterial and fungal growth may degrade PV on the filter surface. Inhibition of fungal and bacterial growth is necessary to ensure PV survival on filters during transit from field collection to the processing lab. Shipping on icepacks at 4C is costly, thus finding an alternative is ideal. Preservative agents were investigated as an alternative to reduce microbial growth while not affecting PV recovery from its performance methods. Preservatives investigated included sodium azide, calcium propionate, o-phenylphenol, and sodium benzoate. Preservative solution or PBS control was pumped into the positively charged Virocap filter and eluted with beef extract, pH 9.50. After 1.5 hours, the eluate was pumped out, pH adjusted, and dosed with 10^2 PFU/mL PV1. Filters were run in duplicate and samples were plated on BGMK cells for enumeration by plaque assay. 0.0195% sodium azide eluate had a 64% recovery when compared to PV expressed in the PBS control eluate. 0.1% calcium propionate had a 102% recovery, 2% sodium benzoate had a 101% recovery, and 0.02% o-phenylphenol had a 111.1% recovery. Sodium azide is not recommended as a good preservative for PV due to low recovery, but 0.1% calcium propionate, 2% sodium benzoate, and 0.02% o-phenylphenol should be investigated further for PV preservation and recovery in wastewater over time.

POSTER SESSION 1

Balcony, Easel 120

11:00 AM to 1:00 PM

Reawakening After TTM: A Comparison of Treatment Temperature and Sedative and Paralytic Medications

Jamie Ann (Jamie) Bottman, Fifth Year, Nursing
UW Honors Program
Kathryn Michelle (Kat) Ordon, Senior, Nursing
UW Honors Program
Mentor: JoAnne Whitney, Biobehavioral Nursing & Health Systems
Mentor: Christine Laux, Cardiology, Harborview Medical Center

Cardiac arrest is a serious and often life-threatening event that can result in devastating outcomes. Targeted temperature management, or TTM, is a treatment utilized after cardiac arrest which improves patient outcomes. Determining the best treatment temperature and combination of sedative and paralytic medications, whose purpose is to slow the brain's metabolism and maintain brain tissue oxygenation, will improve this beneficial treatment for future patients. The purpose of this study was to compare the time to 'reawakening', defined as the patient following commands, between post-cardiac arrest patients who received different combinations of paralytic and sedative medications and who were treated at 33C or 36C during TTM. Time to 'reawakening' after TTM is a critical factor in this patient population in terms of each patient's prognosis. The sub-aims of this study were to determine if time to 'reawakening' was influenced by: 1) cooling patients to the target temperature of only 36C, and 2) the patient's temperature when signs of shivering occurred during the TTM protocol. We were interested in studying these two aims because cooling patients to the target temperature of 36 degrees is expected to decrease the incidence of shivering and therefore less sedative and paralytic will be needed. Additionally, knowing what patient temperatures increase the incidence of shivering will better direct the dosing and timing of medications. Data for this study was retrieved through a retrospective chart review of 200 patients who received TTM treatment at Harborview Medical Center. Once we determine which treatment temperature and medication protocol results in the fastest reawakening and least amount of shivering, the results may influence future TTM protocols and could influence the care that future post-cardiac arrest patients receive.

TTM could change in a way which ensures patients have the best possible outcomes after experiencing a traumatic event like cardiac arrest.

POSTER SESSION 2

Commons East, Easel 84

1:00 PM to 2:30 PM

Synthesis of CdSe Nanotetrapods for Applications in Hybrid Organic-Inorganic Photovoltaics

Ila Kuntum, Senior, Materials Science & Engineering
Undergraduate Research Conference Travel Awardee
Mentor: Christine Luscombe, Materials Science & Engineering
Mentor: Katherine Mazzio, Materials Science and Engineering

Solar energy is arguably the most promising source of renewable energy because it is thought to be both the cleanest and most abundant source. Several types of photovoltaics are now available, including inorganic, organic, and hybrid organic-inorganic. While inorganic photovoltaics have high efficiencies, good charge carrier mobilities, and relatively long charge carrier times, their widespread implementation has suffered from expensive production and materials competition with the microelectronics industry. Organic photovoltaics are solution processable and applicable to flexible substrates; however, their output has been hindered by their low charge carrier mobilities and short exciton diffusion lengths. Hybrid organic-inorganic photovoltaics have been introduced in an attempt to overcome the shortcomings of both organic and inorganic photovoltaics. Inorganic semiconductors are used in hybrid photovoltaics as the electron acceptor due to the ease of changing their size and shape, and therefore the bandgap, of these materials, which allows them to contribute to the photocurrent of the cell while being solution processable and potentially enhancing the conductivity. Conjugated polymers are used as electron donors due to their large absorption cross-section and solution processability. This project addresses the synthesis of hybrid cadmium selenide (CdSe) nanotetrapods, which we believe will facilitate control of the direction of electron motion in the active layer of the cell. Amines are needed for CdSe tetrapod functionalization with semiconducting polymers according to our reaction scheme. Tetrapods tend to convert into quantum dots because dots are thermodynamically favorable; our approach to have kinetic control, and thus have the tetrapods retain their shape, has involved synthesizing the tetrapods with amines as ligands. The reaction time, growth temperature, ligand type, and monomer concentration are used to control the synthesis, and the effects of each variable on the size and shape of the tetrapods will be studied via transmission electron microscopy (TEM).

POSTER SESSION 2

Commons East, Easel 85

1:00 PM to 2:30 PM

Living Polymerization via C-H Activation

Jeremy Housekeeper, Senior, Chemistry, Biochemistry
Mary Gates Scholar, UW Honors Program, Washington Research Foundation Fellow
Mentor: Christine Luscombe, Materials Science & Engineering

An efficient and environmentally benign means of creating semiconducting polymers is necessary for the commercialization of organic electronics. Furthermore, it is crucial that as much control as possible be exerted over the polymerization process. To these ends, two polymerization methods are useful – C-H activation and living polymerization. First, C-H activation is a collection of synthetic techniques where C-H bonds undergo direct catalytic alteration to yield new homo- or heteroatom linkages. Whereas organometallic reagents were traditionally used to achieve these results, C-H activation allows for shorter syntheses utilizing less-hazardous reagents and broader functional group compatibility. Living polymerization is a form of addition polymerization and in our case, the number of chains is constant during the reaction and dependent on the catalyst-to-monomer ratio. This allows for much narrower mass distributions of the desired polymer and more consistent growth. To achieve this, benzoxazole-based monomers containing a C-O electrophile are to be reacted in the presence of a zero-valent nickel species with electron-rich phosphine ligands. By increasing the electron density on the metal center, we aim to facilitate a "ring-walking" mechanism at higher temperatures than previously thought possible. Monomer synthesis and polymerization results are detailed.

POSTER SESSION 2

Commons East, Easel 56

1:00 PM to 2:30 PM

Determining the Role of Defects in Poly(3-hexylthiophene) Nanowires for Organic Photovoltaics

Charles (Charlie) Garcia, Senior, Materials Science & Engineering
Kenneth Khang Nguyen, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr
Mentor: Christine Luscombe, Materials Science & Engineering
Mentor: Katherine Mazzio, Materials Science and Engineering

Interest in renewable energy resources has increased in recent years due to the rising demand and dwindling supply of fossil

fuels. While inorganic materials, such as silicon, have traditionally dominated the solar energy market, the use of organic photovoltaics (OPVs) has grown more popular due to their potential to be low cost, light weight, and their ability to comply with flexible substrates. Poly(3-hexylthiophene) (P3HT) is a polymer that readily self-assembles into nanowires under proper conditions, resulting in nanowire domain sizes that are on the order of the exciton diffusion length. Directing polymer self-assembly provides an opportunity to control the structure property relationships of OPVs and can greatly improve charge transport within the active layer. The regioregularity of a polymer is a measure of the uniformity of its geometric isomers. Because individual P3HT chains begin to kink into S-like shapes during self-assembly, a correlation between the P3HT regioregularity and the frequency of resulting nanowire defects is expected. In an attempt to understand the process of self-assembly, we would like to determine if these defects are incorporated into the nanowires during self-assembly, or if they are excluded from their crystalline domains. To investigate this, P3HT nanowires were made from solutions of anisole and chloroform in varying ratios, heated at 70 C and thoroughly mixed for 24 hours, then removed from heat and allowed to self-assemble for at least three days. These solutions were then filtered to separate the nanowires from the decanted solution, and analyzed separately. A variety of characterization methods were used to study the presence of nanowire defects as well as their effects, including nuclear magnetic resonance spectroscopy, gel permeation chromatography, differential scanning calorimetry, atomic force microscopy, and matrix-assisted laser desorption/ionization spectroscopy.

POSTER SESSION 2

Commons East, Easel 57

1:00 PM to 2:30 PM

Evaluation of Ag and Au Nanoparticle Concentrations in Respect to Performance Enhancement in Organic Photovoltaics

Tucker Murrey, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr
James P. (Jamie) Herold, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr
Mentor: Christine Luscombe, Materials Science & Engineering

Plasmonic nanoparticles (NPs) have been reported to improve the performance of organic solar energy harvesting devices. Gold (Au) and silver (Ag) are two of the more commonly researched plasmonic nanoparticles. The plasmonic effect occurs when incident light induces a fluctuation of electron clouds within a metal. This phenomenon resonates at a specific wavelength depending on NP size, geometry and the dielectric constants of the metal and medium. Previous publications have shown that inclusion of combined Ag and Au NPs increases light absorption and can enhance the power conversion efficiency by 20 percent. This study evaluates the effect of varying concentration of Ag and Au NPs on power conversion efficiencies within a bulk heterojunction (BHJ) organic solar cell, and examines the mechanisms behind the enhancement. Lumerical FDTD Solutions was used to model scattering and plasmonic resonance in OPV devices with different combinations of 40 nm Ag and Au NPs within the PEDOT:PSS charge transport layer. Light enhancement and absorption was modeled as a function of wavelength and spatial arrangement. The results indicated that the absorption profile for the mixed NP device was dominated by the contribution of the Ag NPs, which prompted the investigation into the ideal NP concentrations/ratios. OPV devices were constructed on an ITO substrate with a PTB7:PC70BM active layer. Power conversion efficiencies were determined experimentally as a function of open-circuit voltage, short-circuit current density, and fill factor. Device morphologies were evaluated using atomic force microscopy (AFM). The absorption profiles of the devices were measured using UV-Vis spectroscopy. The optimal concentrations of Ag and Au NPs were determined. Future research on this topic should focus on optimizing particle geometry, ligands, and dielectric NP coatings.

POSTER SESSION 2

Balcony, Easel 100

1:00 PM to 2:30 PM

Food Insecurity on the University of Washington Tacoma (UWT) Campus

Nghia (Peter) Le, Senior, Healthcare Leadership (Tacoma Campus)
Eileen Papale, Junior, Healthcare Leadership (Tacoma Campus)
Mentor: Christine Stevens, Nursing and Healthcare Leadership Programs

Across the United States, there is a paucity of data about food insecurity among university students. For this project, we are defining food insecurity as a lack of access to nutritious food and reduced intake due to reduced income or household demand. Currently, UWT does not know if there is an issue with food insecurity among students nor the reasons if insecurity does exist. This research used mixed methods which included a catalyst survey of the entire UWT student body to document the prevalence of food insecurity. The second method is a community mapping about food resources near UWT. Various types of food resources exist; however, we hypothesize that there are few affordable meal resources within a 10-minute walking distance of the UWT neighborhood causing barriers to accessibility. We defined a meal as hearty and filling food providing enough energy, strength, and nutrients to sustain through short periods of time (1-3 hours), an

entrée (consisting of more than one food group) and beverage ranging from $6.00 - $8.00. We analyzed data to create user-friendly tools such as maps, databases, and websites for the UWT student population to access affordable food resources. By doing this research, our hope is to generate awareness of the need for more food resources and provide resource information for affordable food within the UWT community. UWT is projected to grow to 7,000 students by 2020; therefore, the availability of affordable food resources will impact the academic performance of the University of Washington Tacoma students. Each UWT student's journey to success can be supported by the availability of affordable food resources that impacts their health (mind, body, spirit); as a result, students will not have this barrier in achieving their potential and UWT will successfully meet its mission and values.