Online Proceedings

Poster Session 1

MGH 241, Easel 142

11:00 AM to 1:00 PM

Modular Process for Fiber-Based Device Production and a Novel Organic Photovoltaic Architecture

Kien Quy Nguyen, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr

Mentor: Christine Luscombe, Materials Science & Engineering

Organic photovoltaic (OPV) cells are an emerging technology that is experiencing continued breakthroughs such as reaching a power conversion efficiency (PCE) of 17.3% in August, 2018. OPVs have the potential to become a major source of energy in our future and a more sustainable energy option than traditional solar cells. In addition to contributing a lower environmental impact than common silicon-based solar cells, OPV cells can be made to be flexible, lightweight, and are comparably inexpensive to fabricate. They are also quite customizable via molecular engineering providing the opportunity for much novel architecture. Our research team focuses on innovating a modular processing system for OPV cells in the form of multi-component fibers by continuously coating device layers onto wires and winding the fiber with a secondary electrode. Using a small, user-friendly system allows us to focus on the most important factors that affect the morphology and PCE of the resulting OPV fiber. After characterizing the fibers we are able to consider what changes need to be made to the modular system, allowing us to better advise on the design of a larger-scale manufacturing process for organic photovoltaic fibers.

Session 1G

Psychosocial and Physiological Dynamics of Resilience and Well-Being

Session Moderator: Judith A Howard, Sociology

MGH 238

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Multiple Chemical Sensitivity: Exploring Global Research Inconsistencies and Deficiencies

Tahni C. Mc Gaughy, Junior, Interdisciplinary Arts & Sciences, UW Tacoma

Mentor: Christine Stevens, Nursing and Healthcare Leadership Programs, University of Washington Tacoma

All over the globe, an escalating number of people are developing distressing sensitivities to our environment's everyday intoxicants. Multiple chemical sensitivity (MCS)—also termed idiopathic environmental intolerances (IEI), among other names—is an acquired disorder characterized by a wide range of symptoms and reactions to low-level chemical exposures. Studies conducted in Japan, USA, Sweden, and Denmark found that 12% of the population has been diagnosed with chemical hypersensitivity, while total underreported prevalence is estimated between 15% and 27%. More importantly, research states that prevalence has increased by 300% within the past decade. People diagnosed with MCS experience a range of symptoms, examples including asthma, heart irregularities, headaches, dizziness, confusion, skin irritation, and fatigue. Abundant in our everyday environment, commonly reported triggers include pesticides, building or renovation materials, car exhaust and chemical smog, smoke, perfumes and fragrances, and cleaning supplies, among others. With a myriad of proposed titles, contrasting research perspectives and approaches, and a staggering dissensus on physiology and diagnosis, it is critical that we compare and contrast the existing literature by geographical region. Three primary research hubs generate the majority of contrasting MCS research; these regions include the United States and Canada, Scandinavia, and Japan. The problematic inconsistencies include (1) a lack of consensus definition or diagnosis for the illness, (2) varying perceptions on pathophysiology, and therefore (3) contrasting treatment strategies. This research aims to examine the global, contrasting research approaches, proposals for treatment or action, and subsequent healthcare experiences within the geographical regions of focus. Preliminary results suggest that inconsistencies in the medical diagnosis of MCS lead to deficiencies in research and ineffective healthcare. By any given title, the escalating number of chemically hypersensitive patients is a growing global health concern. Integrating the globally contrasting approaches and diagnosis criterion is the first step to developing efficient healthcare strategies.

SESSION 1S

USING ANTHROPOLOGY TO UNDERSTAND OUR PAST AND PRESENT

Session Moderator: Stephanie Selover, Near Eastern Languages and Civilization

JHN 111

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Intersectionality and Mortality: Oppression, Health, and Black Women in the United States

Katherine E. Mijal, Senior, Interdisciplinary Arts & Sciences, UW Tacoma
Mentor: Margaret Griesse, SIAS, University of Washington, Tacoma
Mentor: Christine Stevens, Nursing and Healthcare Leadership Programs, University of Washington Tacoma

My research is on the intersectionalities of racism and sexism as they apply to the healthcare of women of color, and specifically that of African-American women's maternal mortality rate. African-American women die of after-birth complications at a rate that is three times higher than that of White women. I am using Critical Race theory and Intersectional Feminism to analyze how racism and sexism are interconnected, and how they together implicitly bias many healthcare professionals. I am working from the viewpoint that racism is widespread throughout American society, and highly influences the way that people of color, and white people, live their lives. However, I also believe that an intersectional approach is necessary to fully understand the influences on women's healthcare, and that examining the sexism inherent in women's care is vital to understanding the full extent of the bias society holds against Black women. I am creating a literature study on the history of bias in the medical system with a focus on historical methods of medicalizing racism, researching the explanation for Black women's historical distrust for the white healthcare system, and a focus on current research on implicit bias among healthcare professionals. I am hoping to discover whether the underlining differences in Black women's maternal mortality rate, due to their societal positionality, is being addressed by their doctors in their healthcare strategies. I am hoping to show that a healthcare system which addresses bias and the biological and psychological effects of racism and sexism rather than ignoring them and treating every woman the same is vital to ensuring every woman's optimal health outcome.

SESSION 1T

BRAIN FUNCTION, DYSFUNCTION AND REPAIR

Session Moderator: Kathleen Millen, Pediatrics

JHN 175

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Using Resting-State Functional Connectivity to Detect Uncomplicated Mild Traumatic Brain Injury

Josh Wolfe, Senior, Psychology
UW Honors Program
Mentor: Tara Madhyastha, Radiology
Mentor: Christine Mac Donald, Neurological Surgery

Detection of uncomplicated mild traumatic brain injury (mTBI) is difficult because there are no visible brain lesions that are often associated with more severe forms of TBI. New biomarkers would allow doctors to more sensitively screen for mTBI using neuroimaging methods. One promising biomarker technology is resting-state functional connectivity, which is brain activity measured at rest using functional magnetic resonance imaging. One particularly salient resting-state network is the Default Mode Network (DMN). Our research focused on identifying differences in resting-state functional connectivity between individuals diagnosed with mTBI and healthy controls. We examined mTBI in 254 U.S. military personnel deployed to a combat theatre in the Middle East from 2010-2013. Each subject underwent initial magnetic resonance imaging and screening for TBI following medical evacuation to Landstuhl Regional Medical Center (LRMC), the primary triage center for all evacuated combat casualties, up to 30 days post-injury. We used four distinct groups for our analysis; Blast/Non-Blast (n=79, 44) TBI, and Blast/Non-Blast Control (n=35, 96) while covarying for age and gender. We hypothesized that resting-state networks will be disrupted in TBI and blast populations when compared to controls. We used two different methodologies; the first was a seed-based analysis examining group differences in the correlations from the Posterior Cingulate Cortex (PCC, a key hub within the DMN) to the whole brain. The second analysis used the Yeo Seven Network parcellation to compute correlations between all seven networks to the DMN. We were unable to distinguish any group from controls, suggesting that early differences in functional connectivity are not a robust biomarker of injury.

POSTER SESSION 2

Balcony, Easel 105

1:00 PM to 2:30 PM

Investigating the Role of Sarcomere Structure in the Proliferative Capacity of Cardiomyocytes to Improve Methods of Cardiac Regeneration

Anna Whitney Klug, Senior, Bioengineering
Levinson Emerging Scholar, Mary Gates Scholar
Mentor: Charles Murry, Pathology
Mentor: Christine Yoo

Myocardial infarction (MI) is the leading cause of death globally. Methods to regenerate cardiac tissue after MI has focused on inducing proliferation in adult cardiomyocytes near infarcted tissue or injecting stem cell-derived cardiomyocytes with proliferative capacity into the infarcted tissue. However, optimal regeneration has not been achieved with these methods, as the mechanism behind adult cardiomyocyte proliferation is not well understood and proliferative stem cell-derived cardiomyocytes are phenotypically and functionally immature. Exploration of the mechanism of cardiomyocyte proliferation is therefore necessary to enable optimal regeneration of cardiac tissue and function and MI. We hypothesize that the sarcomere structure, the basic muscle unit of the cardiomyocyte, is the limiting factor in proliferation of cardiomyocytes. To investigate this hypothesis, we have performed a thorough characterization and comparison of stem cell-derived wild type cardiomyocytes (WTC-CMs) and troponin I double knock out cardiomyocytes (TNNIDKO-CMs) which have an incomplete sarcomere structure due to the lack of troponin I. After confirming TNNIDKO-CMs and WT-CMs only vary in their sarcomere structure, we developed a coculture platform to demonstrate the mechanical weakness of TNNIDKO-CMs sarcomere structure. We then performed proliferation assays utilizing multiple proliferation markers to observe if proliferation was higher in the TNNIDKO-CMs with the incomplete sarcomere structures. Preliminary results have shown that TNNIDKO-CMs are more proliferative than WTC-CMs, thus implicating that sarcomere structure plays a role in controlling cardiomyocyte proliferation. Successful characterization of TNNDKIO-CMs and their increased proliferative capacity will elucidate the sarcomere structure's role in proliferation as well as develop a more comprehensive understanding of the underlying mechanism behind proliferation to help progress therapies for regeneration of cardiac tissue after MI.

SESSION 2P

CHEMISTRY AND MATERIALS FOR ENERGY

Session Moderator: Daniel Kirschen, Electrical Engineering

JHN 022

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Quantitative Analysis of the Morphology, Optoelectronic Properties and Processing Conditions of Organic Photovoltaics

Anton Benjamin Resing, Senior, Materials Science & Engineering
Mary Gates Scholar, Washington Research Foundation Fellow
Mentor: Christine Luscombe, Materials Science & Engineering
Mentor: Wesley Tatum, MSE

Solar energy has unmatched potential as the energy source of the future and semiconducting polymers (SP) offer a unique set of properties that can address many of the current barriers that restrict solar technology. SP are exciting because they have untapped potential for improvements in efficiency and they offer a cheap, energy-efficient alternative to silicon due to the ability to scale their production to industrial applications via film deposition techniques, like roll-to-roll printing. Solution processing via roll-to-roll printing is transformative, allowing for low-energy, high-throughput manufacturing of flexible devices. Previous work by Tatum and Resing investigated crystallinity in SP film microstructures through the self-assembly of highly ordered nanowires. This project expands upon this by utilizing a Python classification program to generalize relationships between morphology, optoelectronic properties and processing conditions of organic photovoltaics (OPV). Films of these materials will eventually enable stretchable and deformable electronic devices, but the nano- and microstructures are currently stochastic and inconsistent in their morphologies and resulting properties because processing and chemical conditions influence the domain size of the components and the distribution of those domains throughout the film. Using atomic force microscopy (AFM), a relatively cheap and quick technique, the active layer domains have been spatially resolved based on differences in their mechanical properties. These properties are strongly correlated to electronic performance factors such as fill-factor, short-circuit current and open-circuit current. For this project, OPV with an active layer of Poly(3-hexylthiophene):Phenyl-C61-butyric acid methyl ester has been fabricated with systematically varied processing conditions. A library of data has been established, containing AFM images, the device morphology and OPV performance data. This experimental data set of unprecedented compositional resolution aids in the evaluation of cutting edge simulation techniques, creating a more accurate computerized simulation model for OPV.

POSTER SESSION 4

Commons East, Easel 60

4:00 PM to 6:00 PM

Modeling Firn Densification to Improve Paleoclimate Research and Predict Sea Level Rise

Tova Samantha Beck, Junior, Architectural Design
Mary Gates Scholar, NASA Space Grant Scholar, UW Honors Program
Mentor: Edwin Waddington, Earth And Space Sciences
Mentor: Christopher Stevens, Earth and Space Sciences

The study of firn is integral to determining past climate from ice cores and calculating present and future melt runoff from ice sheets. The Herron and Langway model is a semi-emperical firn densification model. While the model's simplicity makes it easy to use, it assumes constant temperatures and accumulation rates, but Earth's climate is changing. The goal was to recalibrate the model by adding data from new ice cores to a gap in the model's dataset to create more accurate depth-density curves. Preliminary results show the recalibration is a better fit for 57 percent of depth-density profiles. The recalibration could help determine melt runoff, informing sea level rise forecasts. The recalibration could also increase the precision of timing between past CO2 and air temperature changes.