Spring 2019 Meeting

will be organized

at Carroll College, Helena, MT

Postdoctoral research associates, graduate, and undergraduate students are invited to give oral presentations from any and all fields of chemistry and related sciences and engineering.

The thematic focus will be on undergraduate research achievements!

Please contact Prof. David Hitt or Prof. Julie Kessler at dhitt@carroll.edu or jkessler@carroll.edu.
Meeting Schedule of Events

All scientific events will take place in the main building of the Chico Conference Center.

Saturday, October 13th

~1 pm arrival, registration, check-in at the lodge for those staying overnight
  (equipment check, setup for all speakers; coffee/tea & cookies will be provided)

Thematic focus on MT Materials Science Graduate Program

1:30 – 1:50 pm  Madisen McCleary: Effect of Aluminum Titanate (Al$_2$TiO$_5$, ALT) Doping on the Mechanical Performance of Solid Oxide Fuel Cells

1:50 – 2:10 pm  Märtha Welander: Enhanced Redox Resilience in ALT doped NiO-YSZ SOFC anodes

2:10 – 2:30 pm  Md Salah Uddin: Surface Tortuosity and Determination of the Fracture Toughness of Additive Manufacturing Materials by the Fractal Method

2:30 – 2:40 pm  coffee/tea and cookies break

2:40 – 3:00 pm  Denis Liyu: Pulsatile Electro-osmotic Separations in Microfluidics

3:00 – 3:20 pm  Grace Purnell: Unusual Surface Behavior of Coumarin152 Solutes at the Aqueous-Silica Interface

3:20 – 3:40 pm  Katie Link: Cooperative Adsorption of Lipid Films and Soluble Sugars at the Aqueous/Vapor Interface

3:40 – 4:00 pm  Emerald Ellis: The Influence of Solvent on the Structure and Reactivity of Dithranol

~4 pm setup (please only use the provided masking tape)

1. Japhanna Burns: Using Quantitative PCR to Estimate the Number of Mercury Methylating Bacterial 16S rRNA Gene Templates from Flathead Lake-bed Sediments

2. Alexander Fryett: Ligand K-Edge Study of M(PDTC)L Complexes


4. Rachel Matt: The Impact of Heavy Metal Exposure on Glucose Uptake in Adipose and Myotube cells

5. Kyle Olson: Reduction Kinetics of Undoped and Aluminium Titanate (Al$_2$TiO$_5$) Doped NiO-YSZ Solid Oxide Fuel Cell Anodes

6. Joelle E. Romo: SAPO-34/5A Zeolite Bead Catalysts for Furan Production from Xylose and Glucose

7. Courtney Stinger: The Impact of Cadmium Exposure on Exosome Signatures in Lung Tumorigenesis

8. Marietta Stringer: Recovery Study of Polychlorinated Biphenyl (PCBS) in Fish Tissue


10. Mary India Trogden: Neuronal Inflammation

11. Jade Yazzie: The Impact of Environmental Heavy Metal Toxins on Glucocerebrosidase Enzyme Activity

~6:30 pm Meeting Banquette (Chico salad, prime rib and sockeye salmon, roasted red potatoes, berry crisp)

~7:30 pm Keynote Lecture: Professor Erik Grumstrup

Sunday, October 14th

8:30 – 11:30 am  Chico Sunday brunch

10 am  MT ACS LS Board Meeting in the lower lodge’s board room w/ coffee and tea
Keynote Presenter:

Dr. Erik Grumstrup
Assistant Professor of Materials Science
Department of Chemistry and Biochemistry,
Montana State University, Bozeman, MT 59717

“From Photons to Electricity: Understanding How Chemistry Tunes Next-Generation Solar-Cell Materials”

The keynote speaker will discuss two main topics in his presentation. He will begin by highlighting the global energy problem, particularly as it pertains to the developing world and its impact on the climate stability of the planet, the US, and Montana. He will then transition to a discussion of ongoing work in his research group at MSU, aimed at developing and understanding novel materials for cheaper and more efficient solar cells. In particular, he will explain how laser microscopy can be used to perform conceptually simple experiments that reveal the fundamental limiters of efficiency in next-generation solar cell materials.


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Excerpts from Montana Section ACS Bylaws...

**BYLAW V. Officers, Executive Committee, and Councilors**

**Section 1.** The officers of the Section shall be members of the SOCIETY and the Sec on and shall consist of the Chair, Chair-Elect, Secretary, and Treasurer. The Secretary and Treasurer positions may be held by the same person.

**Section 4.** The dues of the officers shall be such as usually pertain to their offices, together with those required by these bylaws and by the Constitution on and Bylaws of the SOCIETY, and such other duties as may be assigned to them from me to me by the Executive Committee.

4.a. The duties of the Chair shall be to preside at meetings of the Executive Committee, to carry into effect the decisions and recommendations of that Committee, to preside at meetings of the Section to conduct governance business, to appoint, with the approval of the Executive Committee, all committee chairs and committee members except as stated elsewhere in these bylaws, and to carry out the duties required by the Constitution and Bylaws of the SOCIETY.

4.b. The duties of the Chair-Elect shall be to assist the Chair with the direction and management of the Section. In the absence of the Chair, the duties of the office shall devolve upon the Chair-Elect.

4.c. The duties of the Secretary shall be to keep a record of the minutes of the meetings of the Sec on and of the Executive Committee, to maintain a list of members and affiliates, to send to members and affiliates such notices as the business of the Section may require, to submit a report to the Sec on at its annual meeting, and to carry out the duties required by the Constitution and Bylaws of the SOCIETY and elsewhere in these bylaws. The Secretary shall preside over meetings in the absence of both the Chair and Chair-Elect.

4.d. The Treasurer shall have charge of the funds of the Section, keep an accurate record of all receipts and disbursements, receive dues, and make those disbursements approved by the Executive Committee. The Treasurer shall render an account of all transactions and of the financial condition of the Section to the Executive Committee at times set by the Committee, and shall submit such reports as are required by the Constitution and Bylaws of the SOCIETY.
THE INFLUENCE OF SOLVENT ON THE STRUCTURE AND REACTIVITY OF DITHRANOL

Emerald Ellis, Robert Szilagyi, and Jennifer DuBois
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Many members of the antibiotic monooxygenase family catalyze direct reactions between their substrates and molecular oxygen without an O₂-activating cofactor. To understand how the network of weak interactions in the protein environment activate a substrate analog, dithranol, for reaction with O₂, the effects of solvent characteristics on its structure and reactivity were examined. Acid/base titrations in aqueous buffer and in dimethylsulfoxide show that the fluorescence emission spectrum of dithranol depends on its protonation state. Under acidic conditions and in chloroform, dithranol does not fluoresce, but under alkaline conditions it does fluorescence, indicating aromaticity in the fused rings. In DMSO, the fluorescence emission intensity is intermediate and the absorbance spectrum suggests a mixture of protonated keto and deprotonated enolate. Oxidation of dithranol requires that the chemical environment controls the gap between the non-reactive keto and the activated enol forms. Using density functional theory, implicit solvation models based on a polarizable continuum can reduce the keto/enol gap to 22 kJ/mol relative to the gas phase 45 kJ/mol, which is insufficient for spontaneous reaction. Therefore, explicit solvation, where the electrostatic and covalent interactions are treated quantum chemically, was examined for solvents with zwitterionic character, and the enol and enolate forms were found to be much more achievable. One-electron redox potentials were computed for each isomer in various solvents, and the enolate was found to be the most reactive form under all conditions. Experimentally, the rate of dithranol oxidation under ambient conditions is greatly enhanced when deprotonation is promoted.

COOPERATIVE ADSORPTION OF LIPID FILMS AND SOLUBLE SUGARS AT THE AQUEOUS/VAPOR INTERFACE

Katie Link, Gabrielle Spurzem, and Robert Walker
Montana State University, Bozeman, MT
Email: katie.link1@msu.montana.edu

Sea spray aerosols (SSA) show much higher organic content than is expected based on the natural abundance of organic material found in bulk seawater and even the sea surface microlayer (SSML). Experiments described in this work investigate whether or not cooperative adsorption can be a driving force for this increase in soluble organic molecules in SSA. Cooperative adsorption describes an interaction between an insoluble Langmuir film adsorbed to the aqueous/vapor interface and soluble organics that would normally not be enriched at the surface. This cooperative interaction arises from non-covalent interactions and would drive the organic molecules to the surface to interact with the Langmuir film, resulting in an increase in soluble organics at the SSML and into the SSA forming at the SSML. We investigate this model using sum frequency generation vibrational spectroscopy (SFG-VS), differential scanning calorimetry (DSC), and surface tension measurements on model systems comprised of biologically relevant lipid monolayers and soluble sugars in both weakly acidic (pH 5.9) and basic (pH 9.0) solutions.
Oral Presentation Abstracts

PULSATILE ELECTROOSMOTIC SEPARATIONS IN MICROFLUIDICS

Denis Liyu and Aaron Thomas

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Improved microfluidic chips will be a more cost-effective solution for point-of-care testing based on protein separation. In the field of molecular biology, separation has been a constant challenge that this project will address. A microfluidic chip utilizing oscillating electro-osmotic flow (EOF) will substantially increase the amount of possible field tests that can be developed for clinical applications. In this talk, we will present our proposal for separation of high-density lipoproteins using microfluidic devices, and how this could be used to screen for heart disease. First, we will provide an explanation of the concept of oscillating EOF that can be applied for separation of proteins with different molecular weights. In addition to this, protein adsorption into polymers and the challenges that presents for this project will be discussed. A potential solution for this problem lies in selection of the materials, and the coating or doping of polymer walls with materials that prevent adsorption. A technique that could simplify this process, Solvent Immersion Imprint Lithography, will be presented here as well. Lastly, we will present how the results of this study could be applied in other diagnostic challenges for the general improvement of human health.

Oral Presentation Abstracts

EFFECT OF ALUMINUM TITANATE (Al₂TiO₅, ALT) DOPING ON THE MECHANICAL PERFORMANCE OF SOLID OXIDE FUEL

Madisen McCleary and Roberta Amendola

Montana State University, Bozeman, MT

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The development of novel materials plays a fundamental role in the design of efficient, reliable and economically feasible renewable energy systems such as solid oxide fuel cells (SOFCs). Due to the inherent brittleness, the reliability of SOFCs depends critically on the mechanical properties of their ceramic components. Aluminum titanate (Al₂TiO₅, ALT) has been proven to be efficient in the stabilization of Ni/YSZ anode performance in terms of slow degradation rates, and high power output. This research found that ALT doping (up to 10 wt%) remarkably improves the mechanical properties of Ni/YSZ anode material in the oxidized and reduced states. In both cases, the development of a secondary phase was observed proportional to the doping amount of ALT. Morphological analysis with preliminary phase identification along with the reduction mechanism and the cause for strength enhancement are presented and discussed.
Oral Presentation Abstracts

UNUSUAL SURFACE BEHAVIOR OF COUMARIN 152 SOLUTES AT THE AQUEOUS-SILICA INTERFACE

Grace Purnell and Robert Walker

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Time-resolved fluorescence and nonlinear optical methods were used to examine solute behavior at hydroxylated silica/aqueous interfaces. Data show that Coumarin 152 (C152) in the interfacial region experiences a distinctly nonpolar solvation environment. Specifically, C152 adsorbed to the silica/aqueous interface appears unable to form a TICT state upon photoexcitation, behavior consistent with solvation in a less polar, aprotic solvent. Unlike the nonpolar solvation reported at silica/methanol interfaces where hydrophobic methyl groups form a bilayer structure and the solvent is thought to partially de-wet from the surface, we propose that ‘nonpolar’ solvation at silica/aqueous interfaces results from restricted water mobility due to strong hydrogen bonding to surface silanol groups. This was confirmed by SHG spectra of the interface and both fluorescence and SHG results from a modified, non-polar silica interface.

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Oral Presentation Abstracts

ENHANCED REDOX RESILIENCE IN ALT DOPED NiO-YSZ SOLID OXIDE FUEL CELL ANODES

Märtha Welander and Robert Walker

Montana State University, Bozeman, MT

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Solid Oxide Fuel Cells (SOFCs) are high temperature energy conversion devices that produce electricity efficiently and sustainably. High operating temperatures required for SOFC function endow these devices with many advantages including fuel flexibility and high conversion efficiencies. However, high temperatures and strongly oxidizing/reducing conditions also present challenges to observing mechanisms responsible for charge transfer and material changes. Experiments in our group use operando Raman spectroscopy and electrochemical measurements to identify and quantify how secondary materials such as aluminum and titanium oxides affect SOFC performance and durability as a function of temperature, ambient fuel composition and polarization. Recent experiments have quantified the effects of aluminum titanate (ALT) doping in standard NiO-YSZ anodes on SOFC resilience when subjected to repeated electrochemically-induced reduction and oxidation (redox) cycling. ALT addition has been shown to slow degradation rates by a factor of two due to the increased stability of the Ni catalyst microstructure. Similarly, ALT seems to confer significantly more resilience to doped anodes upon exposure to environmental redox cycling under both gentle and aggressive oxidizing conditions. The benefits of strategically adding small amounts of secondary phase materials to standard Ni-YSZ SOFC anodes is relevant not only for the design and fabrication of more durable and efficient electrodes for SOFC purposes, but also for improving heterogeneous catalysis in general where sintering of nano-scale catalytic particles proves problematic.

Poster Presentation Abstracts

NEURONAL INFLAMMATION

India Trogden, Felicia Blandov, and Christina Rush

Salish Kootenai College, Pablo, MT

Email: feliciablandov@student.skc.edu

The rate of neuro degenerative disorders (NDD) is increasing exponentially as a large portion of the population continues to age. The average medical cost of a single neuro degenerative diseases and disorders includes 35% of global health costs (WHO) (1). This cost does not include the emotional and physical toll that a single disorder takes on the rest of the family. Approximately 22 % of the American adult population has been affected by NDD (1). In 2016 NDD cost the medical community a little under 2 trillion dollars and this cost is expected to rise by at least 9% each year (1). There are many obstacles around the development of a cure or aid for symptom management protocols. One such obstacle is having an in vitro model that mimics the cell structure of NDD. It has become common practice in the field to use inflammation of neuronal cells as a working in vitro model of NDD. Astrocytes are the sentinels of the neuronal cells in the human brain. Recent studies, including projects at the Rush Medical University, have demonstrated the activation of astrocytes is a hallmark of NDD (2). Current literature highlights experiments causing inflammation of astrocytes using pharmaceutical compounds. However, there is significantly less information about reducing neuro inflammation with the use of traditional medicinal compounds. The purpose of this project is to develop a working in vitro model of NDD. Astrocytes are the sentinels of the neuronal cells in the human brain. Recent studies, including projects at the Rush Medical University, have demonstrated the activation of astrocytes is a hallmark of NDD (2). Current literature highlights experiments causing inflammation of astrocytes using pharmaceutical compounds. However, there is significantly less information about reducing neuro inflammation with the use of traditional medicinal compounds. The purpose of this project is to develop a working in vitro cell protocol and explore the benefits of a more traditional pathway of healing. This process of experimentation can be achieved by incorporating traditional treatments of inflammation of the in vitro astrocyte cell line HMC3.

References:
THE IMPACT OF CADMIUM EXPOSURE ON EXOSOME SIGNATURES IN LUNG TUMORIGENESIS
Courtney Stinger, Chloe Bryson, and Wendy Westbroek
Salish Kootenai College, Pablo, MT
Email: chloebryson@student.skc.edu

A disproportional amount of pollution sources is located on or near Tribal land, such as mines and toxic waste dumps. This contributes to heavy metal toxin contamination of Tribal natural resources, resulting in documented health disparities, such as cancer, in Native American communities. Cadmium (Cd) is an environmental heavy metal toxin and human carcinogen. Two sources of Cd exposure in Native American communities are mining and smelting activities and tobacco use. Studies have established a link between Cd-exposure and lung cancer in both Native American and non-Native communities but the molecular mechanism of this relationship remains elusive. Exosomes are small vesicles secreted into the extracellular environment when endosomal multi-vesicular bodies fuse with the plasma membrane. Exosomes are of interest to the cancer research field because of their involvement in release of pro-invasive factors and initiation of pre-metastatic niches. The impact of Cd-exposure on lung exosome signatures and effects on tumorigenesis has never been explored. We hypothesize that Cd exposure contributes to changes in lung exosome signatures. First, we developed and applied a work flow for capturing exosomes from cultured A549 lung cells by differential centrifugation. This was followed by in-depth biochemical characterization of captured exosomes for validation of quality and reproducibility. In future studies, we will compare protein signatures of exosomes from Cd-exposed and non-exposed A549 lung cells with LC-MS/MS. This work will lay the foundation for characterization and elucidation of exosome-related molecular pathways in lung cancer. Ultimately, this will facilitate the future development of novel therapeutic and diagnostic tools.

USING QUANTITATIVE PCR TO ESTIMATE THE NUMBER OF MERCURY METHYLATING BACTERIAL 16S RRNA GENE TEMPLATES FROM FLATHEAD LAKE-BED SEDIMENTS
Japhanna Burns and Christina L. Rush
Salish Kootenai College, Pablo, MT
Email: Japhannaburns@student.skc.edu

This project examines climate-related environmental changes and the health effects of bioaccumulation of methylmercury in the ecosystem and fish on the Flathead reservation. Goals of the project are to establish sampling and microbe analysis of the Flathead lake sediments, rizosphere and Flathead watershed areas. The hypothesis is that certain populations of microbiota live in and around the Flathead lake and have the ability to methylate mercury thus allowing it to bioaccumulate in the environment. Experimental procedures will be to use DNA and RNA isolation from samples of lakebed soil and sequencing against known methylators to identify the local microbe populations.
Poster Presentation Abstracts

LIGAND K-EDGE STUDY OF M(PDTC)L COMPLEXES

Alexander Fryett, Siana Wiles, Tayler Songer, and Matt Queen

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Carbon tetrachloride is a known carcinogen that can cause cancer related illnesses when it is dechlorinated by cytochrome P450, located in the human liver. Environmental reduction of carbon tetrachloride can produce lesser chlorinated intermediates, such as the trichloromethyl radical, which is harmful to living organisms. [Cu(PDTC)L]⁻ has shown to be able to dechlorinate carbon tetrachloride bypassing lesser chlorinated intermediates producing only carbon dioxide and chloride. The mechanism for the dechlorination is poorly understood. This study focuses on linking the dechlorination reactivity of [Cu(PDTC)L]⁻ and its electronic structure using ligand K-edge orbital coefficient quantitation. These experimental orbital coefficients are compared to theoretical calculations.

Poster Presentation Abstracts

SAPO-34/5A ZEOLITE BEAD CATALYSTS FOR FURAN PRODUCTION FROM XYLOSE AND GLUCOSE

Joelle E. Romo, Ting Wu, Xinlei Huang, Jolie Lucero, Jennifer L. Irwin, Jesse Q. Bond, Moises A. Carreon, and Stephanie G. Wettstein

Montana State University, Bozeman, MT

Email: jennifer.irwin9@gmail.com

Furans such as furfural and 5-hydroxymethylfurfural (HMF) hold value in their role as versatile chemical intermediates produced from bio-based platform chemicals and can be transformed to a variety of fuels and chemical commodities. Xylose and glucose, as well as biomass containing these sugars, can be converted to furans by a dehydration reaction using a homogeneous catalyst such as sulfuric acid. Using a heterogeneous catalyst in place of the homogeneous catalyst allows for easier catalyst recovery, a reduction of corrosive material handling, and improved downstream reactions. In this study, SAPO-34 zeolite bead catalysts were synthesized by growing a layer of SAPO-34 crystals on zeolite 5A beads and characterized through X-ray diffraction and BrØnsted site density measurements. These bead catalysts were then used in catalytic dehydration reactions to produce furfural from xylose and HMF from glucose. Analysis of multiple catalysts at specific reaction temperatures showed positive results for HMF selectivity and levulinic acid production. At 463 K, SAPO-34/5A bead catalysts had four times the HMF selectivity and zero levulinic acid compared to a 0.02 M sulfuric acid catalyst. As well, the bead catalysts were easier to recover than the SAPO-34 powder catalyst and no significant loss of activity was shown after three rounds of bead recycle. SAPO-34/5A bead catalysts show promise for furfural and HMF production from sugars in dehydration reactions and a greater specificity of the catalyst and the support bead could increase yield and selectivity.
The number of people suffering from Type 2 diabetes has reached epidemic levels worldwide, with high numbers of affected adults, adolescents, and children suffering in Native American communities. In Type 2 diabetes glucose levels in the blood are increased due to insufficient insulin usage by muscle and adipose cells, the main cell types involved in insulin-dependent glucose uptake. Mining activities on Tribal lands have contributed to the pollution of Tribal waters, and therefore the food chain, with heavy metal toxins. Studies have suggested that exposure to heavy metal toxins might impact the development and progression of Type 2 diabetes. In this study, we research the impact of heavy metals such as mercury on glucose uptake in muscle and adipose cells. First, we established myotubes from C2C12 myoblasts precursors and adipose cells from 3T3-L1 precursors. Differentiation of both cell types was visually assessed and verified by expression of specific markers with western blotting. Next, we performed a 2NBDG-based glucose uptake assay on C2C12 myotubes including treatment with a glucose transporter inhibitor as a negative control. Our results indicated significant differences in glucose uptake between inhibitor-treated cells versus non-treated cells. Future experiments include glucose uptake assays on cells treated with various heavy metals in a dose-dependent manner. This study could provide new insights into the role of heavy metal toxins and their potential impact on Type 2 diabetes.
**Poster Presentation Abstracts**

**AB INITIO THERMODYNAMIC STUDY OF AQUEOUS IRON-SULFUR CLUSTERS**

*Montana State University, Bozeman, MT*

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Holding a key to the origins of life and at the same time, to the chemical function of extant metalloproteins found in every domain of life, iron-sulfur [Fe-S] clusters take a central role in bioinorganic chemistry and metalloenzymology. My poster focuses on the superfamily of radical S-adenosylmethionine (SAM) enzymes that are being investigated by several laboratories at Montana State University. The use of quantum computational method complements these experimental work. In my work, I utilize the level of theory that was shown to be most accurate for [Fe-S] clusters. I supplement this theory with implicit solvation models that are validated using hydration of iron and sulfur ions. These ions combined form a cascading series of [Fe-S] clusters and later on nanoparticles before the bulk FeS (mackinawite) phase appears. Geochemical characterization of Fe-S precipitation indicates a barrier less, spontaneous cluster for formation process. Utilizing a two-step computational treatment that includes corrections to the translational entropy and inclusion of empirical dispersion correction can reproduce experimental thermodynamic values within an order of magnitude. I use this validated method to predict specific stoichiometries for [Fe-S] clusters that represent thermodynamic wells along the spontaneous recombination processes toward the formation of site-differentiated [4Fe-4S] clusters found in radical SAM metalloenzymes.

**Poster Presentation Abstracts**

**REDUCTION KINETICS OF UNDOPED AND ALUMINUM TITANATE (Al₂TiO₅) DOPED NiO-YSZ SOLID OXIDE FUEL CELL ANODES**

Kyle Olson, Madisen McCleary, and Roberta Amendola  
*Montana State University, Bozeman, MT*

Email: kyle.olson5@msu.montana.edu

Undoped and 1–10 wt% aluminum titanate, Al₂TiO₅, (ALT) doped nickel oxide/yttria-stabilized zirconia (NiO/YSZ) anode materials were kinetically evaluated during isothermal (800 °C) H₂ reduction (5% H₂-95% N₂ and pure H₂ gas). It was found that the two parameter Avrami-Erofe’ev model (AEn) was the most successful in representing reduction kinetics. The reduction mechanisms have been identified as the formation and growth of nuclei and are maintained after ALT doping and when the H₂ concentration in the gas flow is increased. ALT doped samples result in the formation of NiAl₂O₄; which, when present in sufficient amounts, slowly reduces causing a shift of the model from the experimental data. This phenomenon has been correlated, through microstructural evaluation, to the formation of Ni nanoparticles. In all investigated cases, the reduction kinetics of the system was accelerated when the H₂ concentration was increased from 5% to 100%.
Poster Presentation Abstracts

THE IMPACT OF CADMIUM EXPOSURE ON EXOSOME SIGNATURES IN LUNG TUMORIGENESIS

Courtney Stinger, Chloe Bryson, and Wendy Westbroek

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A disproportional amount of pollution sources is located on or near Tribal land, such as mines and toxic waste dumps. This contributes to heavy metal toxin contamination of Tribal natural resources, resulting in documented health disparities, such as cancer, in Native American communities. Cadmium (Cd) is an environmental heavy metal toxin and human carcinogen. Two sources of Cd exposure in Native American communities are mining and smelting activities and tobacco use. Studies have established a link between Cd-exposure and lung cancer in both Native American and non-Native communities but the molecular mechanism of this relationship remains elusive. Exosomes are small vesicles secreted into the extracellular environment when endosomal multi-vesicular bodies fuse with the plasma membrane. Exosomes are of interest to the cancer research field because of their involvement in release of pro-invasive factors and initiation of pre-metastatic niches. The impact of Cd-exposure on lung exosome signatures and effects on tumorigenesis has never been explored. We hypothesize that Cd exposure contributes to changes in lung exosome signatures. First, we developed and applied a workflow for capturing exosomes from cultured A549 lung cells by differential centrifugation. This was followed by in-depth biochemical characterization of captured exosomes for validation of quality and reproducibility. In future studies, we will compare protein signatures of exosomes from Cd-exposed and non-exposed A549 lung cells with LC-MS/MS. This work will lay the foundation for characterization and elucidation of exosome-related molecular pathways in lung cancer. Ultimately, this will facilitate the future development of novel therapeutic and diagnostic tools.

Poster Presentation Abstracts

RECOVERY STUDY OF POLYCHLORINATED BIPHENYL (PCBs) IN FISH TISSUE

Marietta Stringer and Jesse Stine

Salish Kootenai College, Pablo, MT

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Polychlorinated biphenyls (PCBs) are man-made organic chlorine compounds formerly used as insulating material in electric equipment, such as transformers and capacitors. PCBs have been banned since 1979. However, they are resistant to degradation, can remain intact in the environment for extended periods of time and have become widely distributed geographically. PCBs accumulate in fatty tissues of living organisms and the consumption of contaminated organisms can cause serious health issues. Because PCBs accumulate in the lipids of organisms an efficient extraction techniques must be used to analyze such samples. The focus of this study was to develop a consistent extraction method for PCBs using an accelerated solvent extractor (ASE). ASE is a method for extracting various chemicals from a complex solid or semisolid sample matrix. The process uses high temperature and pressure, which results in the extraction taking less time and requiring less solvent than traditional methods. PCBs were extracted using an ASE and then analyzed with a GC-MS instrument. Fish samples were spiked with a PCB standard and the recovery was measured comparing two different ASE solvents, iso-octane and hexane. Once a consistent extraction method is verified, we will use the method to measure PCBs in other animal tissues as well. Animals throughout the food chain can provide valuable insight into the health of the environment. And by measuring the PCB concentration in various animal species the overall health of the environment can be monitored.
PRELIMINARY OBSERVATIONS OF FAST CARRIER MIGRATION IN TIME-RESOLVED EMISSION SPECTRA OF CsPbBr_3 PEROVSKITE

Joseph Thiebes, Casey Kennedy, and Erik Grumstrup

Montana State University, Bozeman, MT

Email: joseph@thiebes.org

Time-resolved emission of cesium lead tribromide (CsPbBr_3) perovskite thin films was observed to shift at early times (under 12 ns after photoexcitation). TCSPC, with a 400 nm excitation beam, was used to collect a range of emission decay kinetics at wavelengths spanning its observed emission spectrum (480-570 nm). Within the first 5 ns, the spectra undergo a 10-20 meV red-shift. Then, at approximately 5 ns, the spectra either begin to blue-shift or remain at the lower energy. After approximately 12 ns, the net spectral shift ranges from approximately -20 meV (red-shift) to more than 20 meV (blue-shift) from the emission peak at approximately 2.35 eV. In experiments showing a net red-shift, the emission decay kinetics at wavelengths red of the emission peak (approximately 537 nm) were slower than wavelengths blue of the emission peak (approximately 517 nm). Preliminary results comparing the spectral shift to the predominant morphology and size of domains sampled suggest that larger, more homogeneous domains are correlated with red shift at early times, while smaller, more heterogeneous domains appear to be correlated with blue shift at later times.

NEURONAL INFLAMMATION

India Trogden, Felicia Blandov, and Christina Rush

Salish Kootenai College, Pablo, MT

Email: feliciablandov@student.skc.edu

The rate of neuro degenerative disorders (NDD) is increasing exponentially as a large portion of the population continues to age. The average medical cost of a single neuro degenerative diseases and disorders includes 35% of global health costs (WHO) (1). This cost does not include the emotional and physical toll that a single disorder takes on the rest of the family. Approximately 22 % of the American adult population has been affected by NDD (1). In 2016 NDD cost the medical community a little under 2 trillion dollars and this cost is expected to rise by at least 9% each year (1). There are many obstacles around the development of a cure or aid for symptom management protocols. One such obstacle is having an in vitro model that mimics the cell structure of NDD. It has become common practice in the field to use inflammation of neuronal cells as a working in vitro model of NDD. Astrocytes are the sentinels of the neuronal cells in the human brain. Recent studies, including projects at the Rush Medical University, have demonstrated the activation of astrocytes is a hallmark of NDD (2). Current literature highlights experiments causing inflammation of astrocytes using pharmaceutical compounds. However, there is significantly less information about reducing neuro inflammation with the use of tradition medicinal compounds. The purpose of this project is to develop a working in vitro model of NDD. Astrocytes are the sentinels of the neuronal cells in the human brain. Recent studies, including projects at the Rush Medical University, have demonstrated the activation of astrocytes is a hallmark of NDD (2). Current literature highlights experiments causing inflammation of astrocytes using pharmaceutical compounds. However, there is significantly less information about reducing neuro inflammation with the use of tradition medicinal compounds. The purpose of this project is to develop a working in vitro cell protocol and explore the benefits of a more traditional pathway of healing. This process of experimentation can be achieved by incorporating traditional treatments of inflammation of the in vitro astrocyte cell line HMC3.

References:
Mines and toxic waste dumps on Tribal lands are the cause of heavy metal toxin contamination of Tribal waters. These pollutions have contributed to health disparities in Native American communities. Studies have shown a link between heavy metal exposure and Parkinson disease (PD) but the molecular mechanism is not clear. The glucocerebrosidase (GCase) enzyme resides in lysosomes where it turns over glucosylceramide into glucose and ceramide. Several studies have shown that reduced GCase enzyme activity is linked to an increased risk for PD. We wanted to research if GCase enzyme activity is affected by heavy metals such as chromium. We hypothesize that exposure of the GCase enzyme to chromium reduces enzyme activity. First, we cultured human fibroblasts and tested them for GCase protein expression with western blotting. Our results showed that GCase was expressed and that fibroblasts lysates are an appropriate source of enzyme. Next, we performed GCase enzyme activity assays on fibroblasts lysates exposed to different concentrations of chromium. Preliminary data showed that GCase enzyme activity was significantly reduced at 100 ppm, 50 ppm, 25 ppm of chromium. In conclusion, chromium reduces GCase enzyme activity in a dose dependent manner. Future experiments include further testing of chromium and additional heavy metals, such as lead. This work shows for the first time that two risk factors for PD are linked to each other. This work will contribute to the elucidation of this molecular relationship and might provide novel insights into PD.