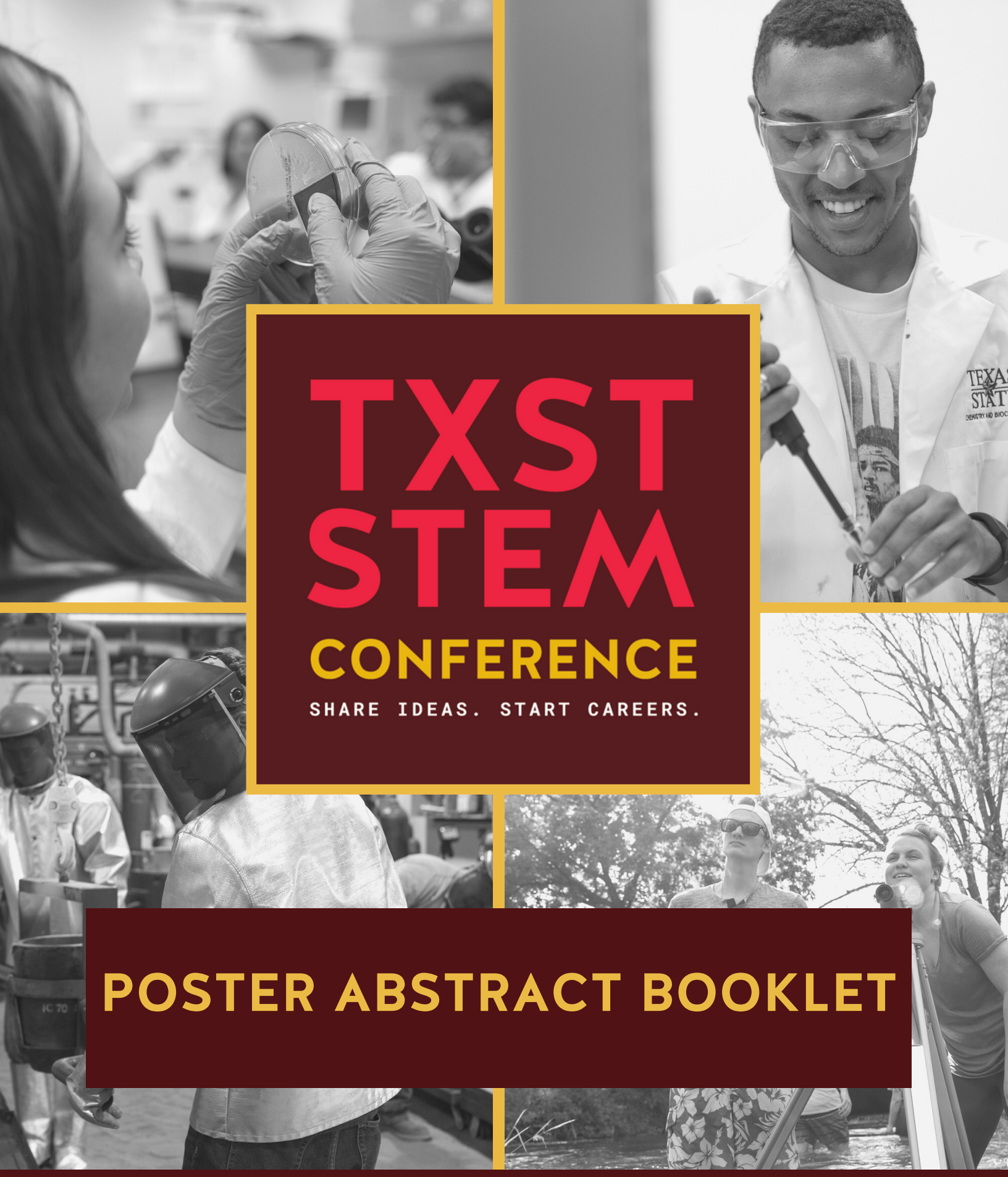

TXST STEM CONFERENCE

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POSTER ABSTRACT BOOKLET

2023 TXST STEM CONFERENCE • MARCH 24TH, 2023

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Research Poster Presentations

AGRICULTURAL/ANIMAL/PLANT/VETERINARY SCIENCE AND RELATED FIELDS

1R-G

U.S. consumer perceptions of insects as livestock feed: Ethical considerations for insects

Mikael N Carrasco
Texas State University, San Marcos, TX, USA

Abstract

Insects have potential to be integrated into livestock production systems as feed, however, must be mass reared to achieve this. Animal welfare regulators have not acknowledged these 'mini-livestock', leaving insect producers to operate in an ethical grey-zone. Consumer attitudes dictate the acceptance of insect production and adoption of insects as livestock feed. Therefore, an analysis of the ethical perceptions of producing insects for livestock feed is justified. The objectives of this study were to: 1. determine if U.S. consumers support or oppose using insects as livestock feed, 2. determine if perceptions of insect welfare or ethics were reasons for opposition, and 3. identify consumers perceived risks and benefits of using insects as livestock feed. We used a quantitative electronic survey and established reliability and validity prior to distribution. Convenience sampling was utilized to survey U.S. adult consumers (n=361). When asked if insects should be used as livestock feed, more than half of respondents were neutral (52%), 34% were supportive, and 15% opposed. Of those who opposed (n=53), 58% indicated having ethical concerns. Gender, age, household income, education level, and previous knowledge were significant factors ($P \leq 0.05$) of whether or not participants thought insects could feel pain. Respondents who were neutral or supportive of using insects as livestock feed (n=308) identified insect welfare (26%) and livestock welfare (29%) as perceived risks. Perceived benefits emphasized environmental sustainability. Our data highlights potential areas of consumer resistance to commercial insect production in the U.S. and suggests producers should establish welfare practices for their insects.

2R-G

Industrial hemp as cattle feed: An *in vitro* analysis

Greyson Fruge, Hannah Boyer, Nicole Wagner, Merritt Drewery
Texas State University, San Marcos, Texas, USA

Abstract

The increasing global population is driving the demand for animal-derived food which intensifies livestock production and feed inputs. Conventional feeds require significant natural resource inputs for production, justifying the need for research into alternative feeds that could be cultivated with less natural resources. Hemp, *Cannabis sativa* L., is a potential alternative feed for cattle due to its productivity, disease tolerance, and small environmental footprint. However, research on the nutritional value of hemp for beef cattle is lacking. The objectives of this study were to characterize the nutrient concentrations, *in-vitro* digestibility (IVD), and cannabinoid levels of different fractions of the hemp plant. Hemp plants were cultivated at Texas State University and fractionated into flower, leaves, stalks, and whole plants. Dry matter, organic matter, acid and neutral detergent fiber (NDF), crude protein, IVD, and cannabinoid levels were determined for each fraction. NDF for most fractions was acceptable (40-56%), except hemp stalks, which had 81% NDF, indicating low forage quality. Organic matter for all fractions was acceptable (69-95%), indicating that hemp plants are rich in organic nutrients. Although other fractions had tetrahydrocannabinol (THC) content <0.3%, which is the legal limit, hemp flower had THC content of 0.52%, indicating there would be challenges using it as cattle feed. IVD of most fractions was within range of conventional feeds (66-93%), except hemp stalks, which had 21% IVD and are, thus, not viable as cattle feed. Our results indicate there is potential for hemp to be integrated into cattle production, but *in vivo* trials are needed.

3R-G

BLACK SOLDIER FLY LARVAE (BSFL) AS AN ALTERNATIVE PROTEIN SOURCE FOR BEEF CATTLE CONSUMING FORAGE

Kayra Tasci, Merritt Drewery
Texas State University, San Marcos, Texas, USA

Abstract

Black soldier fly larvae (BSFL) has potential as an alternative protein source for livestock production because it does not compete with the human food sector and requires less land and water to produce versus conventional proteins, such as soybean meal (SBM). Given the size of the beef cattle sector, investigations into the viability of BSFL as a protein supplement for cattle are warranted. We conducted two experiments (IACUC #7726) using five steers fed low-quality forage in 5 × 5 Latin square designs to evaluate defatted BSFL as a protein source for beef cattle. Experiment 1 determined if cattle readily consume BSFL and included five treatments: 100% SBM; 75% SBM+25% BSFL; 50% SBM+50% BSFL; 25% SBM+75% BSFL; 100% BSFL. Supplement and forage intake were affected by treatment ($P \geq 0.45$). There was an effect of day ($P=0.04$) with steers consuming more supplement on day 5 versus 4. Experiment 2 determined intake and *in vivo* digestion of BSFL and included four treatments of BSFL provided at graded N levels: 0, 50, 100, or 150 mg N/kg BW and one treatment of SBM at 100 mg N/kg BW. Increased supplementation of BSFL linearly increased supplement organic matter (OM) intake ($P<0.01$), forage OM intake ($P=0.04$), total OM intake ($P<0.01$), total digestible OM intake ($P<0.01$), dry matter digestibility ($P=0.01$), and OM digestibility ($P=0.02$). At isonitrogenous levels of BSFL and SBM, intake and digestibility were not different, thus BSFL performs similarly to SBM, which is promising for the commercial integration of BSFL into beef cattle systems.

4R-U

In-situ degradability of hemp (Cannabis sativa L.) components in cattle

Alyssa D Lopez, Emma P Fukuda, Hannah L Boyer, Nicole C Wagner, Merritt L Drewery
Texas State University, San Marcos, Texas, USA

Abstract

The 2018 Farm Bill authorized the expansion of legal production of hemp (Cannabis sativa L.), resulting in increased production due to the versatility and low environmental footprint of the plant. Demand for therapeutic hemp products is increasing, and, as not all plant components are utilized in cannabinoid production, hemp by-products may be marketed as livestock feed. Research assessing the ruminal rate of degradation of different components of the hemp plant is limited. Accordingly, an in-situ trial was performed using three ruminally cannulated steers (IACUC #8497) and 16 hemp samples: hemp leaves, flower, stalk, or whole plant cultivated with four different seed inoculants. Samples were placed in the rumen of each steer and incubated for 0, 4, 6, 12, 24, 48, and 72 h. After samples were removed, they were rinsed and analyzed for partial dry matter (DM), DM, and organic matter (OM). Solubility fractions (immediately soluble, potentially soluble, and not soluble), rate of degradation (kd), and degradability were determined for DM and OM. The potentially soluble DM fraction was 72-74% for each plant component, whereas the potentially soluble OM fraction was 72-75%. Further, hemp stalk had the lowest DM degradability (49%), and flower had the highest (66%). Stalk had the lowest OM degradability (51%); however, leaves had the highest (72%). While potential solubility was similar among samples, kd, OMD and DMD were highest for the flower and leaf components, respectively, indicating they are more suitable for cattle than the whole plant and stalk components.

5R-U

Pelagic fish spared from ocean catch by integrating Black Soldier Fly Larvae in aquaculture production

Evan R Moore, Xiangping Liu, Merritt L Drewery
Texas State University, San Marcos, Texas, USA

Abstract

Sustainability challenges associated with utilizing fishmeal and fish oil sourced from ocean catch as a primary feed in aquaculture production has increased the demand for alternative feeds. Previous research indicates that Black Soldier Fly Larvae (BSFL) can partially replace fishmeal and fish oil in the diets of aquaculture species commonly produced in U.S. without compromising fish growth or feed efficiency. The objective of our study was to identify the amount of pelagic fish in the ocean catch that could be spared from fishmeal and fish oil production by integrating BSFL in the diets of Atlantic Salmon (Salmo salar), Rainbow Trout (Oncorhynchus mykiss), and Whiteleg Shrimp (Litopenaeus vannamei) produced in the aquaculture industry. Annual output for these aquaculture species was collected from the U.N. FAO Fisheries and Aquaculture database for 2017-2019. For each aquaculture species, total metric tons (MT) of spared pelagic fish from fishmeal and fish oil production were calculated based on total lifetime food intake and dietary replacement rates of fishmeal and fish oil by BSFL as investigated in previous literature. Total MT of pelagic fish spared were calculated by taxa for the ten most caught and defined species globally. At the highest level of BSFL substitution for fishmeal that did not sacrifice performance in Atlantic Salmon, Rainbow Trout, and Whiteleg Shrimp diets, 23,283 MT of pelagic fish can be spared from ocean catch for production of these three aquaculture species annually. Therefore, integrating BSFL in aquaculture production can reduce the amount of pelagic fish sourced from ocean catch.

6R-G

BLACK SOLDIER FLY LARVAE (BSFL) AND FRASS (FRS) AS PROTEIN SUPPLEMENTS FOR BEEF STEERS CONSUMING LOW-QUALITY FORAGE.

Shakara Maggitt, Merritt Drewery
Texas State University, San Marcos, TX, USA

Abstract

Protein supplementation maximizes performance for cattle consuming low-quality forage (<7% crude protein, CP). Black Solider Fly Larvae (BSFL) have the potential to be utilized as livestock feed because the CP content (48%) is comparable to that of cottonseed meal (CSM, 49%), a conventional feed. The demand for alternative protein sources has increased, and using insects as livestock feed can be an option. Eight steers (240.2 ± 22.5 kg of BW) were used in simultaneous 4 × 4 Latin squares and received ad libitum access to King Ranch bluestem hay (6.55% CP). All four treatments were infused ruminally once daily: no supplemental protein (CON); cottonseed meal (CSM); partially defatted BSFL meal (BSFLM); and BSFL frass and larval sheddings (FRS) at 100 mg N/kg BW. Four experimental periods were divided as 1) 8-d adaptation to treatments, 2) 7-d measurement of intake and digestion, and 3) 1-d determination of ruminal fermentation. Protein supplementation of CSM, BSFLM, and FRS stimulated forage organic matter (OM) intake ($P<0.01$) relative to CON with no significant differences between CSM and FRS ($P=0.84$) or BSFLM and FRS ($P=0.13$). For TDOMI, there was a significant difference between CSM (2.84 kg/d) and BSFL (3.07 kg/d), and CSM and FRS (3.05 kg/d). Treatment did not significantly affect digestibility of dry matter ($P=0.92$), OM ($P=0.82$), or neutral detergent fiber ($P=0.43$). Based on the data, BSFL and frass may be suitable protein supplements for beef steers consuming low-quality forage.

BIOLOGICAL AND BIOMEDICAL SCIENCES

7R-G

A study of the potential virulence factor Riboflavin in *Pseudogymnoascus destructans*

Saika Anne, Ryan L. Peterson
Texas state University, San Marcos, TX, USA

Abstract

Pseudogymnoascus destructans (*Pd*) causes white-nose syndrome (WNS) and is a novel infectious disease that has been attributed to the rapid decline of some small cave dwelling populations. Infections are often spotted as white powdery blooms on the muzzles and wings of affected bats. Under UV-light, active WNS infection spots can be identified by a characteristic yellow florescence, which is due to riboflavin secreted by *Pd*. Surprisingly, this riboflavin has been identified as a *Pd* virulence factor. Additionally, several other small molecule metabolites have been detected on infected bat wing tissues, presumably secreted by *Pd*. How riboflavin and other small chemical metabolites participate in *Pd* bat colonization and virulence is poorly understood. In this poster, we will describe our efforts to identify conditions leading to the hyperaccumulation and secretion of riboflavin in *P. destructans*. We have developed an assay using synthetic media SD and $LoFlo_{glu,}$ media to monitor riboflavin secretion in the *Pd* growth media. We can measure riboflavin content spectrophotometrically by monitoring emitted light at 528/530 nm after 495 nm excitation. By understanding the mechanism driving riboflavin secretion in *Pd*, new targeted strategies to block riboflavin may be developed to treat WNS in bats.

8R-G

Identification of Potential Oncogenic Target Genes of miR-506-3p in Neuroblastoma

Daniela F Cardus, Mitchell Smith, Alexandra Vernaza, Liqin Du
Texas State University, San Marcos, TX, USA

Abstract

Neuroblastoma is an embryonic malignancy that prevails when immature neuronal crest cells abstain from normal cell differentiation. This aggressive cancer is responsible for 15% of pediatric cancer related deaths. Although differentiation-inducing treatments for neuroblastoma are available, 50% of patients relapse post-therapy. MicroRNAs (miRNAs) are non-coding RNAs that regulate genes post-transcriptionally by targeting the 3' untranslated region (UTR) of mRNA. Tumor suppressive miRNAs that directly target mRNAs of oncogenes could provide a novel impact for cancer therapy. Prior studies have reported miR-506-3p as a tumor suppressive differentiation-inducing agent of neuroblastoma cells, but its mechanism of action is not fully understood. We aim to investigate the direct target genes of miR-506-3p that interpose its differentiation-inducing activity. By gene expression analysis, 283 predicted target genes of miR-506-3p were observed to be downregulated by ≥ 25% at mRNA levels by the miR-506-3p mimic. A siRNAs-based high content screening of the 283 genes using a neurite growth assay identified 19 genes via knockdown that significantly and dramatically induced neurite outgrowth. The R2: Genomics and Visualization Platform was utilized to determine oncogenic potential of these 19 genes in neuroblastoma patients. 12 of the 19 genes were identified to possess oncogenic potential by comparing the overall and event-free patient survival between the low and high gene expression groups of each gene. Altogether, our results suggest that the targetome of miR-506-3p is dominated with genes that promote the oncogenic undifferentiated state of neuroblastoma cells, which further supports the potential of replacement therapy with the miR-506-3p mimic for neuroblastoma patients.

9R-G

Bacteria and nitrite change smelling ability of catfish

Ashley Franklin[1], Nicole Restrepo[2], Camila Carlos-Shanley[2], Mar Huertas[1]
[1]Texas State University, San Marcos, TX, USA. [2]Texas State University, San Marcos, tx, USA

Abstract

Probiotic use is a method of disease prevention in the fish farming industry. Newly built or under-maintained farming pond systems can have buildup of the ion, nitrite, which can be harmful to fish. As part of a probiotic development project, we tested the effects sublethal concentrations of nitrite and of potential probiotics on the catfish's ability to smell. To do this, fish were separated into groups that were either the control group or treated with 0.2 mM nitrite, 0.2 mM nitrite and probiotic candidate food, or probiotic candidate food. The fish were treated for 60 days. Then, electro olfactograms were recorded by opening the nasal cavity of individual catfish, inserting an electrode, and measuring the sensory neuron depolarization as various concentrations of amino acids, bile acids, and bile flowed over the olfactory organ. The results indicate that the control fish smell better than both groups of the probiotic candidate treated fish.

10R-G

Striped bass (*Morone saxatilis*) possess olfactory sensitivity to conspecific chemicals during reproduction

Chironjib Singha Samanta Chandan[1], Linnea K Andersen[2], Robert W Clark[2], Benjamin J Reading[2], Mar Huertas[1]
[1]Texas State University, San Marcos, Texas, USA. [2]North Carolina State University, Raleigh, North Carolina, USA

Abstract

In the US, striped bass (*Morone saxatilis*) is a major aquaculture and sports fishing species. A high percentage of mortality is still observed in hatcheries during the first stages of larvae development for this teleost species. Though sex pheromones and chemical cues are critical factors for successful reproduction and spawning in fish, very little is known about chemical communication during reproduction in striped bass. Our objective is to identify specific odors produced during striped bass reproduction that can elucidate the use of putative sex pheromones in this species. For this purpose, the urine, bile fluid, sperm, and rearing tank water samples of brood male and female striped bass during a reproductive event were collected. Water samples were concentrated by solid-phase extraction. Olfactory sensitivity was assessed by electro-olfactogram (EOG) analysis in juvenile striped bass. The EOG amplitude (mV) was blank-subtracted and normalized using the responses to 10^{-3} mol l^{-1} L-serine. It was found that EOG responses from striped bass had high sensitivity to bile samples, which was followed by sperm, urine, and water samples, respectively. The dilution threshold (1: 10^5) was the same for male and female urine, while the threshold for the water sample was 1: 10^4. However, the dilution threshold (1: 10^8) was higher for male bile, female bile, and sperm. The high sensitivity and specificity of striped bass urine and rearing water indicate the use of urinary chemical signals as sex pheromones in striped bass during the reproductive cycle.

11R-G

Validating the Use of Saliva Samples To Measure Stress Response in Captive Ruffed Lemurs (*Varecia* spp.)

Raymond Vagell[1], Ashley N. Edes[2], Jill D. Pruetz[1]
[1]Department of Anthropology, Texas State University, San Marcos, TX, USA. [2]Department of Reproductive and Behavioral Sciences, Saint Louis Zoo, St. Louis, MO, USA

Abstract

Cognitive research can either be enriching or stressful for the subjects. We would like to take cortisol measurements in real time to monitor whether subjects are experiencing stress while performing cognitive tests. Here, we propose using saliva samples rather than other traditionally used noninvasive sample types like fecal samples, as cortisol shows up in saliva within 1 to 3 minutes of release into the bloodstream. However, biological validation is required to ensure assays are accurately measuring cortisol responses to events. We used handling (net capture) as a stressor for biological validation. Subjects (N=10) were trained to chew on cotton swabs and return them so that saliva samples could be collected. Most subjects showed an increase in cortisol level after exposure to the stressor and a return to baseline 2 hours later, validating that salivary cortisol is a reliable measurement for stress.

12R-G

Investigating the Oncogenic Role of CDKN3 in Neuroblastoma

Alexandra Vernaza, Zhenze Zhao, Liqin Du
Texas State University, San Marcos, TX, USA

Abstract

Neuroblastoma is a childhood cancer that is responsible for more than 15% of children cancer deaths. Neuroblastoma arises from the inability of neural crest precursor cells to obtain cell differentiation along the sympathetic nervous system. Cyclin Dependent Kinase Inhibitor 3 (CDKN3) is a cell cycle regulating protein that prevents the activation of CDK2 which consequently inhibits DNA synthesis in S phase of the cell cycle. CDKN3 acts as an oncogene that increases cell proliferation, formation of malignant tumors, and has been shown to play an important role in prognosis for several cancers. There is currently no literature of CDKN3 in relation to neuroblastoma. A high-content screening of a collection of siRNAs against recognized cell cycle regulators were performed to identify the regulators that control neuroblastoma cell differentiation. The findings show that siRNAs of three cell cycle regulators significantly induced cell differentiation, including CDK4, CDC6, and CDKN3. siCDKN3 demonstrated the greatest cell differentiation effect. To investigate the clinical relevance of CDKN3 expression in neuroblastoma, the correlation of CDKN3 expression level and patient survival in neuroblastoma tumor tissue was analyzed using the R2: Genomics and Visualization Platform. Expression levels of CDKN3 are noticeably correlated with patient survival, concluding that patients with higher expression levels have significantly lower survival probability compared to patients with lower expression levels. Overall, our results suggest that higher levels of CDKN3 in neuroblastoma cells play an integral role in maintaining the undifferentiated status of the cells and contributes to the poor prognosis of neuroblastoma patients.

13R-U

Mobility of a tRNA fragment under biotic stress and its potential involvement in systemic acquired resistance in plants

Sophia L. Kottke, Sharaz Bhatty, Hong Gu Kang, Dinesh Pujara
Texas State University, San Marcos, TX, USA

Abstract

Systemic acquired resistance (SAR) is an immune response to confer long-term broad protection against secondary infections in plants. Signaling molecules such as nitric oxide (NO) and salicylic acid (SA) were shown to be involved in SAR, its signaling molecule traveling between infected and uninfected tissues in plants is unknown. Small RNAs derived from transfer RNAs, termed transfer RNA-derived fragments (tRFs), were recently identified as a transcription remodeling molecule in our laboratory. Herein, we test if this novel tRF is involved in SAR as a signaling molecule. Therefore, a fluorescent-tagged tRF was employed to track its movement in Arabidopsis wild type as well as 8 known SAR mutant plants. Plants were infected with the bacterial pathogen *Pseudomonas syringae* to observe if the mobility of the tRF is altered by infection. *azi1* and *bsmt1*, the mutant lines resulting in reduced SA priming and demethylated SA, respectively, displayed increased fluorescence over the observed time. We are currently performing an independent approach to further characterize the tRF mobility.

14R-U

Poly(lactic-co-glycolic acid)/Polyethylenimine nanocarriers of microRNA for reprogramming neuroblastoma cancer cells.

Josue Osorio, Liqin Du, Tania Betancourt
Texas State University, San Marcos, Texas, USA

Abstract

Neuroblastoma is a type of childhood cancer diagnosed within the first years of life but that begins during fetal development. This cancer develops in the nerve tissue and spreads to the adrenal glands, spinal cord or neck, creating immature nerve tissue or neuroblasts. Protein-coding and nonprotein-coding genes responsible for neuroblastoma cell differentiation have been discovered, and studies have shown that microRNAs (miRNAs) can help to induce neuroblastoma cell differentiation and have oncosuppressive functions. miRNAs are small molecules that regulate gene expression by binding to the messenger RNA (mRNA), thus preventing protein translation. Because of the negative phosphate groups in the miRNA that prevent effective miRNA entry into the cells and the presence of endo- and exonucleases in physiological fluids that can easily degrade the miRNA, it is important to develop a reliable nano vector that can improve cell transfection efficiency.

This work aims to develop poly(lactic-co-glycolic acid) (PLGA) nanoparticles entrapping a polyplex of the cationic polymer polyethyleneimine (PEI) and therapeutic miRNA mimics to be delivered to neuroblastoma cancer cells for inducing cell differentiation and cell growth arrest. Polyplex formation was optimized by tuning the nitrogen over phosphate ratio (N:P) of PEI and RNA, respectively, to neutralize the negative charges of the miRNA. Complex formation was confirmed with gel electrophoresis. Blank PLGA nanoparticles of ~200 nm were prepared via a water-in-oil-in-water double emulsion process. Future work will demonstrate encapsulation of the PEI/miRNA polyplex within PLGA nanoparticles and investigate their ability to enable effective neuroblastoma differentiation therapy.

15R-U

Characterization of RNF175, a Novel Ring Finger E3 Ligase

Jennifer A Perez Espinosa, Micaela Vargas
Texas State University, San Marcos, Tx, USA

Abstract

RING finger (RNF) proteins are a class of E3 ligases involved in processes such as cell division, interferon signaling, proinflammatory pathways, and growth factor signaling to name a few. Although many RNF isoforms have been characterized and associated with their respective functions, RNF175 has yet to be characterized and its regulatory mechanisms remain undefined. In this study we elucidate the characterization and associated pathways of RNF175. Using The Cancer Genome Atlas (TCGA) Genome Data Analysis Center (GDAC), RNF175 is a differentially expressed RING finger protein in glioma cancer cells and high expression of this gene is associated with low survivability of glioma patients. Using bioinformatics, we show, many transcription factor binding sites were found to be prominent in the promoter of this gene, including GRβ, p53, PAX5, and C/EBP. These transcription factors are known to regulate inflammatory responses, cell division, chromatin remodeling, and cell differentiation. Different protein motifs were identified, one being the FYVE motif which binds to PI3P, a phospholipid protein involved in the AKT survival pathway. In addition to the zinc finger binding domain the protein contains 5 transmembrane regions. Microarray shows differential expression of RNF175 in MCF10A human mammary epithelial cell line, upregulation in neutrophil cells during inflammatory responses and highly expressed in the brain. These data show RNF175 interactions with the AKT, ERAD pathway, and cytoskeletal proteins as their protein binding partners. Additional studies will need to confirm if RNF175 is of clinical significance for a diagnostic marker and its role in glioma cancers.

16R-U

Dynamic, reversible cross-linked hyaluronic acid-based hydrogels for drug delivery

Jessica S Peterson, Kushal Thapa, Tania Betancourt
Texas State University, San Marcos, Texas, USA

Abstract

Hyaluronic acid (HA), is an abundant mucopolysaccharide in the human body. When chemically modified, HA can become an integral component of dynamic hydrogels. Hydrogels are three-dimensional, cross-linked networks of hydrophilic polymers. The unique properties of hydrogels and their tunability make them highly suitable for drug delivery and tissue engineering applications. These dynamic HA crosslinked hydrogels can be derived by functionalizing and chemically cross-linking reactive groups along the polysaccharide chain. In this work, HA is modified through three steps to generate HA-benzoacetoacetamide (HA-BCA), which can undergo reversible crosslinking with 4-arm-PEG thiol (PEG-SH) resulting in a hydrogel with dynamic properties. To prepare this, HA was modified into hyaluronate-azide (HA-Azide) through its carboxyl group with Azido-PEG3-amine. HA-Azide was then modified via copper-catalyzed click chemistry to form HA-cyanoacetamide (HA-CA). A Knoevenagel condensation was then used to attach a benzaldehyde to HA-CA to make HA-BCA. Future work will show that hydrogels can be synthesized by mixing HA-BCA with PEG-SH. Conductive polymeric nanoparticles of poly(3,4-ethylenedioxythiophene) (PEDOT) will be added to the hydrogels to act as photothermal agents. The addition of these PEDOT nanoparticles will allow the extent of crosslinking of the hydrogels to be thermally controlled and offers the ability to tune the mechanical and transport properties of the system through laser stimulation. In preparation for next steps, 100-nm nanoparticles that absorb light in the near infrared range and that offer photothermal properties were prepared using an oxidative emulsion polymerization process. This research reports the functionalization, synthesis, and characterization of these dynamic HA based hydrogels.

17R-U

Characterization of Microbiome-derived Probiotics Used for Disease Mitigation in Channel Catfish.

Nicole Aileen Restrepo Caicedo, Ashley Franklin, Mar Huertas Pau, Camila Carlos-Shanley
Texas State University, San Marcos, TX, USA

Abstract

Probiotics are live microbial adjuncts that benefit the host by modifying the environment of its microbial community. The use of probiotics as biological control agents in aquaculture is an increasing research area in aquatic sciences. The initial step in probiotic development is the isolation and characterization of appropriate bacterial candidates using in-vivo testing and genomics. This study focuses on uncovering the attributes of bacterial isolates that are being tested as potential probiotics for protecting channel catfish against the pathogenic bacterium Edwardsiella ictaluri in a previous experiment. Twelve bacteria from channel catfish gut and nose were isolated. Growth curves in liquid cultures were obtained by measuring the optical density at 600nm and colony counting every 12 hours. DNA extractions, phenotypic tests, and whole genome sequencing were used to identify and characterize the bacteria. The results revealed differences in the growth rates between the isolates such as different exponential phase periods. Phenotypic tests show the bacteria are a variety of Gram-positive and Gram-negative bacteria, differing in shape and modes of nutrient uptake. We are currently analyzing the genomic sequences for taxonomic classification and further functional characterization of the isolates. The data acquired in this study contributes to the knowledge on microbial identification for probiotic development purposes and furthers current knowledge on the catfish microbiome.

18R-U

Optimization of Precursor Functionalization for the Synthesis of Dynamically Crosslinked Hydrogels for Drug Delivery

McKenzie M Siller[1], Kushal Thapa[2], Thomas FitzSimmons[3], Adrianne Rosales[3], Tania Betancourt[1]
[1]Department of Chemistry and Biochemistry, College of Science and Engineering, Texas State University, San Marcos, Texas, USA. [2]Materials Science, Engineering and Commercialization Program, Texas State University, San Marcos, Texas, USA. [3]McKetta Department of Chemical Engineering, University of Texas at Austin, Austin, Texas, USA

Abstract

Hydrogels are a three-dimensional network of crosslinked hydrophilic polymers. The tissue-like properties of hydrogels make them suitable as drug delivery systems, wound dressing materials, or scaffolds for soft tissue repair. The chemistry used for crosslinking the hydrophilic polymers that make up the hydrogel can be judiciously selected to provide the hydrogel with tunable properties. Depending on the crosslink identity, the resulting hydrogel can be made to respond to external or internal stimuli such as pH, mechanical stress, and heat by swelling, shrinking, dissolving or solidifying. In our research, we used Michael addition of thiol-ene functional pairs from four-arm PEG thiol (PEG-SH) and four-arm PEG benzylcyanoacetamide (PEG-BCA), respectively, to synthesize hydrogel via the formation of reversible covalent bonds. The nature of these reversible crosslinks is of exothermic nature, making the hydrogel thermosensitive and allowing it to shift between gel and sol states upon thermal stimuli. In this work, the syntheses of PEG cyanoacetamide (PEG-CA), the precursor to PEG-BCA, and of PEG-BCA are being optimized to yield a higher percent functionalization and thereby improve the crosslinking ability of the reversible hydrogel precursors. Specifically, the effect of reagent molar ration on the percent functionalization is being investigated with the aid of proton nuclear magnetic resonance (H-NMR) and absorption spectroscopy.

19R-U

Identification of Potential Anti-Cancerous Activity in Neuroblastoma from a Heterocyclic Compound Library

Jadyn Smith[1], Alexander V Aksenov[2], Nicolai A Aksenov[3], Dmitrii A Aksenov[2], Stanislav V Scherbakov[2], Alexander Kornienko[4], Liqin Du[4]
[1]Department of Biology, Texas State University, San Marcos, TX, USA. [2]Department of Chemistry, North Caucasus Federal University, Stavropol, Russian Federation. [3]Department of Chemistry, North Caucasus Federal University, Satvropol, Russian Federation. [4]Department of Chemistry and Biochemistry, Texas State University, San Marcos, TX, USA

Abstract

Neuroblastoma is a type of pediatric cancer that can exhibit a variety of disease patterns in the abnormal growth of neural crest cell types. Due to limited available treatment options, our lab aims to offer the identification of potential novel therapeutic agents through a series of in-vitro studies. The goal of my research was to test a library of 99 heterocyclic compounds for anti-cancerous activity using a high-throughput screening analysis. Each compound was placed in 96-well plates with the addition of the neuroblastoma cells for a set growth period. For each compound, its effects were measured with the evaluation of remaining cell viability using an MTT assay. Numerical observations were taken based on measuring the light absorbance of a metabolic product catalyzed by an enzyme remaining in living cells. The MTT absorbance analysis worked to identify the compounds that had significantly decreased cell survival when compared to the library mean. The assay identified the top 7 compounds had decreased the neuroblastoma cell viability by over 80%. These screening results overall indicate significant anti-cancerous activity against the neuroblastoma cell type, and the compounds need to be further evaluated for therapeutic effectiveness.

20R-U

Engineering a New Expression System for Purification and Analysis of Phase-Separating Proteins

Sebastian D Velez, Karen A Lewis
Texas State University, San Marcos, Texas, USA

Abstract

La-Related Protein 6 is a protein known to bind to collagen mRNA. It is comprised of multiple domains: the N-terminal domain, La-motif, RNA recognition module, and the C-terminal domain (CTD). The C-terminal domain is predicted to undergo a phenomenon called liquid-liquid phase separation, in which many of these proteins come together to form droplets within a solution, just like oil in water. My research aims to characterize what specific properties influence the formation of these droplets, such as salt concentration, pH, presence of and concentration of RNA, etc., and how the formation of these droplets is used by the cell to regulate LARP6 activity. In order to analyze the CTD and test these conditions, biochemical quantities of the protein need to be expressed and purified. However, the very property that makes these proteins of interest – their ability to phase-separate – also makes them difficult to purify. Our initial attempts to purify the LARP6 CTD have resulted in low and inconsistent yields. Therefore, I have engineered a new expression system that will enable us to purify these proteins under denaturing conditions, in which the phase-separation behavior cannot occur. Importantly, this new expression system is compatible with our previous expression systems, allowing both our lab and our collaborators to quickly begin utilizing the denaturing purification protocol with multiple proteins. The protein that is purified under denaturing conditions will be slowly transitioned into more cell-like solution conditions, thus enabling us to analyze its biophysical behavior using microscopic and spectroscopic methods.

21R-U

Investigating immunity post heat stress in the model cnidarian, *Exaiptasia diaphana*

Haley R Womack, Erin Borbee, Lauren Fuess
Texas State University, San Marco, Tx, USA

Abstract

Coral reef ecosystems are some of the most biodiverse ecosystems on the planet. The foundation of these ecosystems are stony corals which belong to a diverse group of organisms known as cnidarians. Many cnidarians, including stony corals, exhibit symbiotic relationships with microalgal symbionts. Impacts of climate change, including rising sea surface temperatures, trigger a breakdown of this symbiosis, known as bleaching. In tropical corals, the relationship between the host coral and microalgal symbiont is obligate: the coral requires the microalgal symbiont for survival. However, the establishment of symbiosis between corals and their microalgal symbionts comes at the cost of suppression of the coral immune system. Simultaneously, as we have seen heat stress cause bleaching events to increase in frequency and severity across the globe, we have also seen an increase in the frequency and severity of coral disease outbreaks. These disease outbreaks and bleaching events have been linked with significant coral declines across the globe which in turn have had significant impacts on coral reef ecosystems. In this project, I used the cnidarian model system, *Exaiptasia diaphana*, to investigate changes in symbiont density and constitutive immunity both during and following recovery from heat stress. I used fluorescent microscopy to track symbiont density and a suite of traditional immune assays to characterize immune activity throughout the experiment. The results from this experiment will provide new insights on the impacts of bleaching on cnidarian immunity, which will enable future investigations into understanding the intersection of disease and bleaching in cnidarians.

22R-G

Pilot Study: Gut Microbiome of Western Chimpanzees (*Pan troglodytes verus*) at Fongoli, Senegal

Kaelyn Dobson, Carson Black, Katie Gertsner, Camila Carlos-Shanley, Jill Pruetz
Texas State University, San Marcos, Texas, USA

Abstract

The gut microbiome of the Critically Endangered wild Western chimpanzees (*Pan troglodytes verus*) found at Fongoli, Senegal is currently unknown. Gut microbiome diversity and abundances of microorganisms can act as a biomarkers of health status because they are reflective of the chimpanzees' environment, diet, sociality and exposure to harmful bacteria species. Understanding the microbiome of this population helps determine the overall gut health and contributes to continuous conservation and noninvasive health monitoring efforts. This pilot study data takes place in southeastern Senegal at the northwesternmost point where chimpanzee species' range. The Fongoli community home range is in a savanna biome habitat located outside of national park boundaries. Fecal samples (n = 36) were collected by the Fongoli Savanna Chimpanzee Project using ethanol vials and underwent amplicon sequencing of the 16S rRNA gene. MicrobiomeAnalyst was used for microbiome analysis and comparative statistics. We found the core microbiome of the Fongoli chimpanzees includes taxonomic families at include Firmicutes, Baceriodota, Actinobacteria, and Verrucomicrobiota. Season, age and individual comparisons were not significant, but this may be due to the small sample size of the pilot study. Our conclusions will be utilized in establishing a foundation for additional studies of this nature at this research site and provide a first glimpse of the gut microbiome of the Fongoli population.

23R-U

The Dynamics of Ammonia Excretion of Green Swordtials (*Xiphophorus hellerii*) in an Aquaponics Environment

William Ortiz, Alex Tran, Mar Huertas
Texas State University, San Marcos

Abstract

In an aquaponics system, there are many compounds and elements crucial to success. Nitrogen, and specifically ammonia, is imperative to a healthy environment in aquaponics. Ammonia is then assimilated by the plants. In turn the plants grow healthier and contribute to a beneficial microbiome that allows the fish to grow and reproduce. However, one main concern in aquaculture is the excessive buildup of ammonia. Excessive ammonia is toxic to fish and causes stress, organ damage, and will eventually lead to death. There is a delicate balance of enough ammonia to continue the nitrogen cycle and a toxic amount of ammonia. Many fish produced for food using aquaculture, such as tilapia, are able to handle larger concentrations of ammonia. When raising fish to be sold for decorative purposes, the fish tend to be less resistant to ammonia. Balancing the fish biomass and the ammonia concentrations depends on each species of fish. This experiment takes Green Swordtails (*Xiphophorus hellerii*) and determines the concentration ammonia excretion relative to the biomass. The results of the experiment will be useful to determine ideal biomass of X. hellerii in an aquaponics system.

COMPUTER AND INFORMATION SCIENCES AND SUPPORT SERVICES

24R-G

Effects of Community Cultural Wealth on Black and Hispanic Women's Persistence in P-20 Computing Education

Shetay Ashford-Hanserd[1], Toni Moreno[1], April J Mouton[1], Lillianna Carrera[2]
[1]Texas State University, San Marcos, TX, USA. [2]University of Texas, San Antonio, San Antonio, TX, USA

Abstract

Building upon previous National Science Foundation (NSF)-funded research, and research related to STEM persistence and counter-life herstories, this study is part of a larger, longitudinal, mixed-methods sequential, explanatory, NSF CAREER project that examines the influence of community cultural wealth (CCW) on the persistence of Black and Hispanic females in computing majors as they matriculate from middle school into high school, into undergraduate education and into graduate school or the computing workforce. In this preliminary study, Dr. Shetay Ashford-Hanserd, CAREER Principal Investigator (PI) is accompanied by Postdoctoral Scholars, Dr. Lillianna Carrera, and Dr. Toni Moreno, and graduate research assistant, Ms. April Mouton, to illuminate Black and Hispanic women's educational trajectories and lived experiences that have influenced their persistence in undergraduate computing education at a Hispanic Serving Institution in Texas. Data collection instruments include the reliable ACCEYSS STEM+C majors survey instrument and counter-life herstories interview protocol. To provide an anti-deficit understanding of how Black and Hispanic women access their strengths to survive and resist forms of oppression, the CCW model is utilized as a theoretical framework. The CAREER PI modified the CCW model to include spiritual capital because it serves as a critical source of fortitude and resilience in the Black and Hispanic communities. Research findings will highlight how CCW influences Black and Hispanic women's persistence in computing education in response to our collective need to better support this population in their attainment and representation in STEM+C disciplines.

25R-U

Regulating Unmanned Aerial Vehicles Fly-Overs Via Authorization-based Zoning

Abdullah Kamal[1], Jeremy Vidaurri[2]
[1]Texas State University, Austin, Texas, USA. [2]Texas Tech University, Lubbock, Texas, USA

Abstract

With the utilization of unmanned aerial systems becoming increasingly popular, many issues arise regarding security and privacy. Companies such as Amazon and Google are incorporating drones into their own delivery systems. Given this new market, flying over private property raises security and privacy issues. This paper proposes developing zones that utilize Attribute-Based Access Control (ABAC) to allow users to define authorization based on designated policies. With zones that highlight no-fly airspaces, companies will be able to pilot their drones with a lowered chance of interference and legal retribution. This proposed zoning technique will allow property owners to determine which level of privacy they wish to enforce. Utilizing a map that incorporates zoning preferences, our drone path planning algorithm is planned to legally and safely designate a path for any commercial drone flight. Through simulations and indoor testing, we confirmed that our algorithm was able to convert zoning data specified in our application into an optimal path. In this presentation, we demonstrate a solution that connects property owners with prospective drone delivery companies to allow for transparency and optimal system security.

ENGINEERING

26R-U

Inclusion of Diverse Participants in Development of Emotion Portrayal Database

Ana L Hernandez[1], Saira C Valenzuela[2], Ana E Camacho[1], Lois A Umali[2], Ryan Newcomb[1], Damian Valles[1], Maria D Resendiz[2]
[1]Texas State University, San Marcos, TX, USA. [2]Texas State University, Round Rock, TX, USA

Abstract

Currently available databases of emotion portrayal exist, however individuals from diverse backgrounds are often not included. As we develop the Nurture Neurodiversity app that identifies emotions of conversation partners, we want an emotion portrayal database that consists of non-actors from diverse backgrounds so that machine learning can be conducted with data input of individuals from diverse backgrounds. The use of non-actors from diverse backgrounds also allows the machine to be trained with data that contains genuine expressions of emotions, not exaggerated demonstrations of emotions.

The Bilingual Language Acquisition Brains (BLAB) Lab is currently working on developing a diverse emotion portrayal database. Two hundred forty participants participated in interviews where they demonstrated the seven universal emotions: happy, sad, angry, disgust, surprise, fear, and neutral. Videos containing audio and visual information were curated. A team of research assistants provided one of the seven universal emotions as a label. When there were differences in opinion about the emotion being demonstrated, a discussion was held until consensus was reached.

The process for identifying the emotions portrayed in the curated videos allows for the database to mimic how humans perceive emotions and how humans identify emotions. The emotion portrayal database will be used for machine learning by being one source of data that is used to teach machines how to identify emotions. By including people from diverse backgrounds and using human judgments of emotions, the database for teaching machines that identify human emotions will have greater utility in everyday settings with people from various backgrounds.

27R-G

Smart Conductive Concrete

Precious Aduwenye, Xijun Shi
Texas State University, San Marcos, Texas, USA

Abstract

Abstract

This investigation was motivated by the desire to improve the mix design of conductive concrete for field applications while reducing the cost of the material production. Recycled carbon fibers of different lengths (6mm and 12mm) were used in 16 different combinations in order to make concrete conductive. The impact of different testing methods on conductivity was also investigated. Increases in fiber dosage and length were found to directly affect concrete conductivity. Fiber addition caused significant changes in the fresh properties of concrete; slump, and unit weight decreased significantly while air content increased. Concrete conductivity was improved when a higher number of 12mm fibers were used. Based on the testing results, a few optimum mixes were selected using response surface methodology (RSM).

28R-G

Erodibility Characterization of Plastic Riverbed Soils

Muhammad Tasnim Alam, Dr. Stacey Kulesza
Texas State University, San Marcos, Texas, USA

Abstract

The relationship between the erosion rate and the water velocity, or the hydraulic shear stress, are both considered erodibility. Erodibility is essential to measure the scour potential around bridge piers, which is typically analyzed using soil samples collected from the overbanks because they are more accessible. The National Cooperative Highway Research Program (NCHRP-915) provided erosion categories using the overbank soil erosion data obtained from many years of laboratory testing. However, it is likely that the riverbed soil properties, particularly those in the upper meters, are different from the overbank soils. This study aims to evaluate whether or not the erosion categories provided by the NCHRP-915 work for plastic riverbed soils. For this research, ten riverbed soils with plasticity were identified and sampled using shelby tubes. One sample from each site was tested in an erosion function apparatus (EFA). The EFA tests were conducted at a range of water flow velocities between 0.2 m/s and 6 m/s, and the erodibility was determined for each site. The soil was classified based on its properties using the Unified Soil Classification System (USCS). The research found that the ten riverbed soil samples followed the erosion categories included in NCHRP-915. To our knowledge, this is the first study to evaluate plastic riverbed soils' erodibility; this research finding will help evaluate the validity of previous models to predict the erodibility of plastic riverbed soils.

29R-G

Adsorption Potential of Water Lettuce (*Pistia stratiotes*) Biochar for Nitrogen Removal in Water

Eunice O. Babatunde, Ranjit Gurav, Sangchul S. Hwang
Texas State University, San Marcos, Texas, USA

Abstract

Increased anthropogenic activities have resulted in the continued propagation of invasive aquatic plants as well as increased nitrogen contamination in water bodies. This study is aimed at harnessing the adsorptive properties of the water lettuce biomass (WLB) in an environmentally friendly manner for nitrogen removal in aqueous conditions. Biochars have proven to be effective in the removal of contaminants from water and soil. Using slow pyrolysis, ground WLB was transformed into biochar (BC) at 500 °C and 2 hrs. detention time. The BC was modified by sequential washing in HCl and CaCl2 and dried at 105 °C for 12 hrs. The modified BC was used to conduct batch adsorption tests for nitrogen removal. Varying concentrations of 25 ml nitrogen solution were combined with 0.1 g modified BC and agitated on a multipurpose tube rotator at 20 rpm for 24 hrs. to attain equilibrium and optimize pH. At optimum pH of 6, 94% NO3 - N and 80% NH4 - N adsorption was achieved. These results demonstrate the effect of pH and ion interference on the BC adsorption of nitrogen. Furthermore, modified BC produced from water lettuce is an efficient and cost-effective method for significantly removing nitrogen compounds in water. It is recommended that future studies investigate the potential of water lettuce BC for the removal of nitrogen from a variety of sources as well as the removal of organic and inorganic contaminants in water and wastewater.

30R-G

Effect of Oxygen Pressure and Temperature on the Growth of Magnesium Gallate Thin Films by PLD Technique

Md Abdul Hamid, Subrata Karmakar, Brian C Samuels, Injamamul Hoque Emu, Ariful Haque, Ravi Droopad
Texas State University, San Marcos, Texas, USA

Abstract

The fabrication of wide bandgap (WBG) semiconductors with desirable quality is a topic of significant interest in recent past as WBG semiconductors are being widely used in solid-state devices for modern electric vehicles, high-power grids, and high-frequency transistors. The important wide bandgap materials face some technical challenges for device applications i.e., high melting temperature as *SiC* (2730 °C) and *GaN* (2220 °C), hardness (mostly *SiC*), huge crystal defects in *GaN*, and strong anisotropy in *β-Ga_2O_3*. On this regard, magnesium gallate (*$MgGa_2O_4$*) is an emerging WBG semiconductor (bandgap ~5.0eV) with some desirable properties, such as high electrical conductivity, high thermal and chemical stability, easy fabrication process, and so on, for high-power applications. In this study, semi-transparent magnesium gallate thin films have been deposited on c-plane <0001> sapphire substrates by pulsed laser deposition (*PLD*) technique with various oxygen (O_2) pressure ($1.0x10^{-1}$ Torr to $1.0x10^{-4}$ Torr) and different temperatures (500 °C to 700 °C) maintaining a constant deposition rate. The X-ray diffraction spectra analysis has shown that the thin films have a single-phase crystalline structure with preferred plane orientation along (111) direction. Pure single crystalline phase has been observed to form at temperatures ~600 °C and pressure ~$1.0x10^{-2}$ Torr. The elemental composition and chemical states have been determined by X-ray photoelectron spectroscopy technique with individual emission lines of *Mg-2p*, *Ga-3d*, *O-1s*, and *C-1s* core level spectra of *$MgGa_2O_4$*. The findings of this study have tremendous implication in the next generation high-power electronics, deep ultraviolet photodetectors, transparent conducting oxide, and high-frequency light emitting devices.

31R-G

Remediation of water contaminated with Adsorption of Petroleum Hydrocarbon using Water Hyacinth (Eichhornia crassipes) Biomass

Marufa Khondoker, Ranjit Gurav, Sangchul Hwang
Texas State University, San Marcos, Texas, USA

Abstract

Water contamination with petroleum hydrocarbon is steadily increasing due to the global growth of industrialization, massive oil spills frequently occur in the sea while transporting, and some other mismanaged activities and unconsciousness. This rising contamination seriously threatens the environment, marine life, and human health. Water hyacinth (WH, Eichhornia crassipes) is a floating aquatic invasive plant that rapidly reproduces and covers vast amounts of water such as rivers, lakes, and canals, obstructing water movement and depriving dissolved oxygen concentration in water, resulting in the extinction of fish and other species and decreasing biodiversity. This study aims to utilize WH as an eco-friendly adsorbent to remove petroleum hydrocarbon from water, wastewater, and stormwater. At first, a mixture of petroleum hydrocarbon deionized water was prepared mimicking oil spills in waterways. The dried and chopped WH biomass was applied on the surface of the oil-water mixture. The oil adsorption was successful with a 90% oil reduction. However, retrieving WH biomass was challenging. To resolve this difficulty, pouches (2”x2”) were made with a nylon mesh to keep the biomass inside. One pouch was filled with dried and raw WH biomass and the other had bleached WH biomass. The oil adsorption with raw and pretreated WH biomass was 83% and 92%, respectively. These findings imply that both raw and pretreated WH biomass work well as environmentally-friendly and cost-effective adsorbents for petroleum hydrocarbon and can easily be implemented to the impaired waterways contaminated with them.

32R-G

Integration of Diamond on β-Ga_2O_3

Imteaz Rahaman, Saif Taqy, Subrata Karmakar, Ariful Haque
Texas State University, San Marcos, Texas, USA

Abstract

The problem of poor thermal management in β-Ga_2O_3 based devices can be solved by growing a large area thick diamond layer on the β-Ga_2O_3. However, it is challenging to grow diamonds on β-Ga_2O_3 due to the large surface energy difference and thermal mismatch between β-Ga_2O_3 and diamond film. Another key factor for the difficulties in growing diamonds is poor seeding density. In this study, diamond crystals are successfully grown on β-Ga_2O_3 by hot filament chemical vapor deposition (HFCVD) for 1 hour using advanced electrostatic dip seeding technique. Different characterization techniques such as atomic force microscopy (AFM), scanning electron microscopy (SEM), and Raman spectroscopy are used to analyze the surface morphology and quality of the diamond crystals. SEM images support the large-scale deposition of diamond crystals on β-Ga_2O_3 but the average crystal size of diamond is only ~70 nm, which limits its applications on a large scale. A small blue shift is observed in the Raman peak of the diamond film which implies that the diamond film has a compressive stress of ~ 0.69 GPa. Furthermore, the full width half maximum (FWHM) and the ratio of integrated intensity of diamond and non-diamond carbon (I_{DIA}/ (I_{DIA} +I_{NDC}) shows the poor result, which refers to the presence of a significant amount of non-diamond carbon on the film. These findings pave the way for growing large-area diamond films on β-Ga_2O_3, but the quality and size of the diamond crystals need to be improved by optimizing the seeding process and the growth parameters.

33R-G

Implementation of zero waste circular economy for the next generation of agriculture

Hribhu Chowdhury, Dr. Bahram Asiabanpour
Texas State University, San Marcos, Texas, USA

Abstract

With the global problem of population growth and climate change, current challenges to traditional agriculture include a long-term decline in the available arable land, soil depletion, water scarcity and food security. To address these issues, agricultural methods must undergo a significant transformation in order to become more efficient and environmentally sustainable. Soilless agriculture particularly, vertical farming provides the best possible solution to these growing problems. With the growth of vertical farming, it has been evident that many investors have gone out of business because of high investment costs, high maintenance costs, high energy costs, high labor costs and high waste generation. Therefore, this research proposes an integrated organic hydroponic-aquaponic farming system that aims for profitability with zero waste and reduced operational costs through the use of circular economy principles, byproduct utilization, balancing and product selection. Preliminary experiments have been conducted to convert the traditional vertical farming method to a zero-waste circular economy opportunity by using hydroponic plant waste, aquaponic waste, vermicompost tea, and aerobic compost tea/quick compost on the growth of halophyte plants through establishing the infrastructure of hydroponic, aquaponic and secondary farming setup in the Texas State University Greenhouse facility and the supporting Rapid Product and Process (RPD) lab.

34R-G

Large Area Reduced Graphene Oxide Films by Pulsed Laser Deposition and Successive Laser Annealing for Improved Electrical Properties

Istiaq Firoz Shiam, Maria Sultana, Pallab Kumar Sarkar, Subrata Karmakar, Ariful Haque
Texas State University, San Marcos, Texas, USA

Abstract

In recent years, there has been a lot of interest in reduced graphene oxide (rGO), which has a wide range of applications including optoelectronics, electrical sensors, energy storage devices, and as a precursor to pure graphene. Although having good tunability over their optical and electrical properties, rGO has failed to demonstrate good electronic properties such as charge carrier mobility when rGO is produced by well-known multistep processing methods like chemical reduction, thermal reduction, and solvothermal reduction. This study focuses on the single-step fabrication process of large-area rGO by incorporating argon and oxygen gas during the Pulsed Laser Deposition (PLD) and the produced films' subsequent electrical and structural characterization. Raman spectroscopy was used to confirm the grown rGO's structural ingenuity and showed the best ID/IG ratio for 0.5 mTorr Oxygen partial pressure with around 180nm thin film and X-ray photoelectron spectroscopy (XPS) was used to determine the degree of reduction before and after laser annealing. The rGO displayed semiconductor-like activity with an n-type majority charge carrier at room temperature during the electrical characterization. The Hall mobility was observed to increase from 4.22 to 97.8 cm^2/V-s after the pulsed laser annealing (for an applied energy density of 0.5 J/ cm^2 and activation energy of 1.14 meV.

35R-U

Planning Texas Electric Vehicle Infrastructure for Zero Carbon Operations through 2040

Andrea Barreto[1], Justin Williams[2], Jonathan Guillen[2], Jose Castillo[2], Tongan Jin[3], Tao Ma[3], Michelle Londa[3]
[1]Texas State University, San Marcos, TX. [2]Texas State University, San Marcos, Texas. [3]Texas State University, San Marcos

Abstract

As private and commercial electric vehicles (EV) use rise over the next two decades, so does the electricity required to power the fleet. This research implements reliable and easy-access charging infrastructure for sustaining the growing EV fleet in Texas through 2040. Distributed renewable energy is harvested to meet the power needs for state-wide charging stations. The charging infrastructure is designed to operate economically and eco-friendly, thus ensuring return-on-investment and mitigating climate change. Utilizing wind and solar generation to power charging stations provides sustainable sources of energy for the EV fleet without congesting the power grid. Renewables-based chargers reduce the carbon footprint, achieving a zero emissions future. EV and plug-in hybrid EV (PHEV) growth is forecasted for seven regions of Texas by using population data of each region. Individually calculated EV adoption rates are then used to predict how many EV and PHEV are on the road through 2040. Three forecasting scenarios are generated: optimistic, most likely, conservative. EVI-Pro, a web-based infrastructure planning tool, is used to estimate the number of Level 2 and DC fast chargers for each region. Finally, we design and deploy a zero-emission, state-wide infrastructure to support three EV adoption scenarios subject to uncertainty in cost and energy needs.

36R-U

Human Digital Twin

Raymond I Nava, Chaerin Park, Abhimanyu Sharotry, Jesus Jimenez
Ingram School of Engineering, San Marcos, Texas, USA

Abstract

Performing repetitive tasks while in improper posture can lead to severe injuries. Tasks such as lifting, lowering, pushing, or even moving can cause musculoskeletal disorders, leading to injury. According to the National Safety Council, the number of people with work-related medically consulted injuries in 2021 is 4.26 million, and the total cost of work injuries in 2020 cost USD 163.9 billion. Digital Twin (DT) is one of the rising technologies of industry 4.0; DT is a virtual model designed to accurately collect data from several components, which can then be used for predictions, optimizations, and reflecting a physical object in real-time. The CHiPS research laboratory at the Ingram School of Engineering proposed the idea of a Human DT (HDT) model to deal with workers' fatigue. A HDT is a virtual model designed to replicate a worker by collecting data and displaying it to detect and prevent injuries. First, we implement Computer Vision, which estimates the joints of the human body to collect data from workers while performing tasks. Second, we developed an Ergonomic Risk Assessment module to measure the risk factors in a work environment and identify poor postures. Finally, we integrate components into a dashboard for visualization. This HDT is expected to recognize workers' posture, prevent injuries, and improve efficiency and productivity.

37R-G

Heat Transfer Property Characterization of CVD Diamonds on Ultra-Wide Bandgap Semiconductors Using Q-carbon Interlayer

Maria Sultana, Pallab Kumar Sarkar, Ariful Haque
Texas State University, San Marcos, Texas, USA

Abstract

Alongside its exceptional electrical, mechanical, chemical, and optical properties, the highest thermal conductivity of diamond (2200 W/m-K) has emerged as a point of great interest because of its enormous potential as a heat dissipator, enabling the true potential of ultra-wideband gap semiconductor (UWBG) materials for high-frequency and high-power applications. The deposition of diamonds on UWBG semiconductors has been made possible using an ultra-thin Q-carbon interlayer. This Q-carbon, a novel carbon allotrope having 70-80% sp^3 bonds, has shown great potential as an ideal seed layer for CVD diamond, which ensures not only good adhesion but also leads to large-area diamond growth with high nucleation density (10^9 cm^{-2}) and lower inter-film stresses, thereby minimizing film delamination. In the past, though some thermal conductivity measurements have been done on suspended CVD diamonds, diamonds with a diamond nanoparticle seed layer, and diamonds grown on various substrates, the measured thermal properties fell short due to a lack of practical applicability, poor adhesion, and small area growth problems, respectively. In this research, we are planning to measure the thermal conductivity and thermal boundary resistance of CVD diamonds on Q-carbon to characterize the efficiency and device applicability of the polycrystalline CVD diamonds as a heat sink and to study the effect of Q-carbon in the heat transfer phenomena. For the measurement, the steady-state thermo-reflectance technique will be used as it is relatively simple, less costly, and capable of covering a wide range of thermal conductivities (1 to >2000 W/m-K).

38R-G

An empirical study of an Atmospheric Water Generator system by designing and fabrication of air duct for heat sink and operational factors.

Md Hasib Ullah, Dr. Bahram Asiabanpour, Mark Summers
Texas State University, San Marcos, Texas, USA

Abstract

The growth of the human population is increasing day by day and so does the demand for fresh water. Atmospheric water generator (AWG) using Peltier device can mitigate this problem. Peltier device or thermoelectric cooler (TEC) is a semiconductor device that uses the Peltier effect to create a heat flux between the junction of two materials. When DC current is applied to the circuit, the thermoelectric module work as a cooler or heater, it transfers heat from one side of the device to the other depending on the direction of the current. The hot side needs to radiate heat with the help of heat sink so that the cold side can capture water droplets continuously. The aim of this project is to design and fabricate air ducts to improve the cooling of the heat sink and increase the effectiveness of the atmospheric water generator (AWG) system. Different CAD design and their 3D printed model is going to be used to find out the best cooling of the heat sinks. Additionally, different combinations of current and voltage to the Peltier device will be tested to observe the effects on the cooling on the Peltier cold side surface.

ENGINEERING/ENGINEERING-RELATED TECHNOLOGIES

39R-G

Inkjet Printed Thin Film of Two-Dimensional Metal-Organic Framework Based on Nickel Tetracyanonickelate as Solar Cell Material

Md Abdul Halim, Md Abdul Hamid, Gary W Beall
Texas State University, San Marcos, TX, USA

Abstract

The predominant methods for fabricating thin films in the production of electronic and solar cell devices uses chemical and/or physical vapor deposition techniques to process semiconductor materials, including metal oxides and their alloys. Most of these techniques involve large capital investment, high operating, and maintenance cost. Metal-organic frameworks (MOFs) are a class of porous materials that can be solution processed and fabricated into thin films using Inkjet Printing technology for energy storage, catalysis, and flexible electronics applications. Inkjet printing is a versatile and cost-effective method for the fabrication of MOF thin films. However, preparing printable ink with susbtantial shelf life remains a challenge. In this research bulk crystals of nickel tetracyanonickelate MOF were synthesized and exfoliated into two-dimensional (2D) nanoflakes by Liquid Phase Exfoliation (LPE) technique using 1-Dodecyl-2-pyrrolidinone (DDP) as an intercalant. Printable ink was prepared with the exfoliated nanosheets, and the rheological properties of the ink were adjusted by using other chemical reagents. 2D MOF thin films were inkejet printed on flexible substrates such as polyimide and Indium Tin Oxide (ITO). UV-vis spectroscopic analysis was conducted to observe absorption in the wavelenth range from 200-1400nm. The band gap of the printed thin films was found at 1.54 eV for the exfoliated structure. In addition to enabling low-cost mass production, this successful inkjet printing method for MOF thin film may enable creating individually tailored solar cells by allowing for simple design modification based on digital image files.

40R-G

MECHANICAL PROPERTIES OF GLASS FIBER REINFORCED COMPOSITES MADE FROM EXPIRED STEREOLITHOGRAPHY PRINTER RESIN

SM Tawhid Mahmud, Md Ibrahim Khalil Tanim, Wasi Shadman, Md Muhtasim Fuad, Bahram Asiabanpour
Texas State University, San Marcos, Texas, USA

Abstract

This study aims to determine the feasibility of creating glass fiber-reinforced composite materials using expired stereolithography (SLA) printer resin. A mold is constructed employing fused deposition modeling (FDM) printing. Strands of glass fiber are placed with the resin in stages inside the mold, and the curing part is done on subsequent thin layers of the resin by UV light exposure. The mechanical characteristics are assessed using impact and bend tests. This study paves the way for new possibilities in manufacturing products using expired and otherwise unusable resin while retaining the mechanical properties necessary for practical usage. Furthermore, the use of resin after the average lifetime provides an environment-friendly solution by enabling the reduction of wastage. The study demonstrates the possibility of producing composite materials cost-effectively to avoid waste and efficiently utilize resources using expired SLA resin. Besides, this work provides a proof of concept for the use of expired SLA resin and opens the door for further research in this area.

41R-U

Improving Automated Plant Seeding Through Design and Development of Automated Seeder and Route Optimization

Lance J Simon, Bahram Asiabanpour, Mark Summers
Texas State University, San Marcos, TX, USA

Abstract

The fast-growing population of the world, limited access to freshwater and fertile land, and increasing price of energy and labor require new methods and resources to increase food production. Among these methods is utilizing automation in farming to improve productivity and reduce waste and cost. The focus of this study was to improve the planting operation through the automation of planting seeds and adding flexibility in the use of the machine for a variety of plants. In this project, an open-sourced robotic seeder (The FarmBot Genesis) was utilized, modified, and improved to enhance the original function of planting individual seeds in their designated location without a defined travel path. The repetitive function of transferring individual seeds in conjunction with the undefined travel path reduced how efficiently the FarmBot performed. The improvement enables the system to load and carry several seeds synchronously and plant individual seeds in the designated locations. The system, by utilizing "the nearest neighbor algorithm", optimizes the sequence that the FarmBot travels to ensure that it visits all predetermined locations in the least amount of distance and time. The applied modification saves a significant amount of planting time/energy/cost and gives the flexibility to use the system for a variety of plants with different seed shapes and sizes. The mechanism can be expanded to operate all functions of farming including watering, sampling, monitoring, and harvesting. The system is expandable for any scale from lab prototype to full-scale industrial farming.

42R-U

Determining Affecting Factors on the Accuracy of Measuring Elemental Compositions of Materials Using an X-Ray Fluorescence Spectroscopy (XRF) Analyzer

Olivia J Renner, Bahram Asiabanpour
Texas State University, San Marcos, Texas, USA

Abstract

Analyzing elemental composition is essential in optimizing alternative functions of food production. The effective utilization of an XRF Analyzer can be beneficial in these actions but understanding how variables during measurements such as time measured, height from the sample, the angle from the sample, and surrounding lighting can affect the reading can aid in the accuracy of results. Through a series of designed experiments, it can be observed that many of these factors have no definite correlation and prove to be contradicting when isolating measured elements. For the factor of time, 90 seconds did provide the least deviation, but the deviation did not produce a sensible trend. For height, 0 inches from the sample gave the least deviation. The deviation increased as the height increased, but not proportionally. For angle, the deviation generally increased as the angle increased, but there were some discrepancies that were identified and investigated. The factor of the surrounding wavelength did not have a solid trend, but it was concluded that natural settings provided the most accurate measurements. Tentatively, the preferred setting for measurements is a 90-second duration at a 0-degree angle, perpendicular to the sample, with a white wavelength surrounding light. More extensive testing and case studies are required to fully understand these effects and to provide legitimacy to the results.

43R-U

An Empirical Study on the Oil Extraction of Vetiver

Gabriela A Molina, Olivia J Renner
Texas State University, San Marcos, TX, USA

Abstract

The extraction of oil is an essential way to fully utilize resources found in plants that typically are not thought of for consumption. Vetiver is a resilient plant found originally in India whose oils are used in perfumes and other aromatic applications. With the study of its growth, oil extraction processes, and market value comparisons, the most efficient and cost-effective production can be identified. Also, the added value of the processed products (ie. oil, composite) will be explored with respect to lab or industrial applications and scales. This observation will be made through the small-scale growth of this resource in relatively harsh, yet controlled, settings. Additionally, varied formats of fertilizer will be used to observe their impacts on the growth and nutrient quality of the plant. Common distillation and extraction techniques will be used to harvest the oils and subsequent testing of the composition to measure quality. With this, further testing avenues will be highlighted in order to fully analyze the scope of the factors and methods affecting the quality and quantity of oils extracted.

44R-U

Removal of Silica and Nutrients from Reverse Osmosis Concentrate Through Diatom-Based Treatment Outdoors

Kamaya D Bonds, Emma M Clow, Keisuke Ikehata
Texas State University, San Marcos, TX, USA

Abstract

Water scarcity and declining water supply are of great concern globally. Researchers are investigating solutions such as desalination and water reuse using reverse osmosis (RO). RO uses high pressure and a semi-permeable membrane to extract freshwater from salty water or wastewater. Although RO has proven to be reliable, there is still concern about the amount of fresh water recovered and the disposal of the remaining RO concentrate (ROC). When considering RO, about 15–30% of water will be wasted as ROC. This is a large amount of water that has potential to be treated through a similar technique to phycoremediation, which uses algae to remove contaminants from water and/or soil. In this study diatoms were used to remove silica and nutrients from ROC obtained from a full-scale water reuse facility in California. The objective of this study was to examine how the changing conditions like sunlight affect a diatom culture collected from a brackish wetland in Laguna Vista, TX in removing inorganics from ROC. We observed that the silica uptake rate in this experiment was lower compared to indoor lab conditions, this might be due to temperature fluctuations, light availability, and/or other weather patterns. Optimizing the removal of impurities from ROC using diatoms can allow us to use additional RO to retrieve more freshwater. As progress is made, this process could propose a viable solution to these uprising concerns on our potable water to recover more water and reduce the percentage of water originally destined to be wasted.

45R-U

Experimental Growth of Halophytes in Secondary Farming

Christian D Torres, Olivia J Renner, Bahram Asiabanpour, Hribhu Chowdhury, Nicole Wagner, Mar Huertas Pau
Texas State University, San Marcos, Tx, USA

Abstract

Bluewater is being revived at the Texas State Greenhouse located near Ingram Hall. The assignment aims to eliminate any waste in the process of secondary farming or just farming in general. The continuation of the preexisting aquaponic and hydroponic models should utilize material waste in each process and convert into value-added fertilizer. Exploring secondary farming processes is essential in being able to utilize soils in harsh environments. The application of halophytes, especially in developing countries, can provide a stable source of materials for eating, oil extraction, medicinal uses, among other essential uses. To encourage favorable growth, nutrient additives and plant species need to be sampled and tested to find the best combination of fertilizing and care. Based on preliminary testing, it was observed that the halophytes require a very hostile living conditions. Alfalfa and both purslane plants in tandem with the solid waste collected from Miracle Gro and Epsom salt solution provided to be the best outcome. All three plants watered with the solution produced a large variability compared to other quadrants of each specimen watered with the other fertilizers. There are a few flaws that need to be corrected moving forward with our testing. Some halophytes had inconsistent growth and others didn't develop at all due to what is believed to be old or bad seeds. Other issues we ran into were cross-contamination due to improper draining and inconsistent watering/feeding.

HEALTH PROFESSIONS AND RELATED PROGRAMS

46R-G

Cultural Considerations in the Development of the Nurture Neurodiversity App

Lois Adrianne Umali[1], Maria Resendiz[1], Micaela Vargas[2]
[1]Texas State University, Round Rock, TX, USA. [2]Texas State University, San Marcos, TX, USA

Abstract

The worldwide prevalence rate of autism is estimated to be 1 in 100 children. Despite the increase in rate of autism diagnosis around the world, a lack of awareness about autism still persists. In particular cultures, autistic children are stigmatized and seen as violent or demonic. When designing support services such as technology-based apps for autistic children and their families, it is critical to consider various cultural factors. This study will describe how different cultures perceive autistic individuals and how this impacts the development of the Nurture Neurodiversity app. The Nurture Neurodiversity app is a collaboration between Communication Disorders and Engineering which aims to offer support for autistic individuals and their families in a way that honors one's culture and identity. This study will analyze interviews conducted with individuals, families, and professionals who work with the autistic community from the United States, Guatemala, Africa, and Belize. Preliminary findings show that while early access to services is key to better long-term outcomes, families often delay reaching out for services due to cultural stigmas around autism in the Hispanic community. Highlighting the perspectives and lived experiences of community members and autistic individuals, the Nurture Neurodiversity app will be developed with consideration for financial and geographic barriers, cultural differences, and family dynamics.

47R-U

The Evolution of External Beam Radiation Therapy Technology

Samantha D Gomez, Megan Trad Ph.D, MSRS, RT(T), FASRT
Texas State University, San Marcos, TX, USA

Abstract

Background and Purpose: External beam radiation therapy (EBRT) relies on the use of technology to effectively treat cancer. Treatment technology has evolved from simple, low-energy machines to automated, high-energy machines equipped with various imaging modalities. This review explores the earliest kilovoltage machines used to the newest positron emission tomography (PET) linear accelerators utilized today. Additionally, the introduction of onboard imaging (OBI) systems, beam modification devices, and computers to EBRT is discussed. The purpose of this literature review aims to analyze how EBRT technology has changed throughout time and how those changes have impacted the field of radiation therapy.

Methods: The review articles and book chapters analyzed were obtained from Texas State University's ScienceDirect library search database. Keywords include: radiotherapy, discovery of x-rays, innovation, radiation oncology, technology, external beam radiation therapy, history, MR-guided radiotherapy, and PET linac. The material was also obtained from class textbooks of the Texas State University Radiation Therapy Program

Conclusion: Dramatic changes in technology have improved target volume localization, radiation delivery, and the sparing of organs at risk (OAR). Many innovative ways to treat cancer patients, such as adaptive radiation therapy (ART) and biology-guided radiation therapy (BgRT) have emerged with advanced technology. Radiation therapy is an ever-changing field that will continue to have an impact on people with cancer. Steps in the progression of technology can further individualize cancer treatment and expand the role of the radiation therapist as a result.

MATHEMATICS AND STATISTICS

48R-U

Volume Quantization of Stroke Lesions via one-click Constrained Normalized Cut

Michala N Gradner
Texas State University, San Marcos, TX, USA

Abstract

The severity of a stroke lesion is directly proportional to its volume. In order to better diagnose patients with stroke lesions, an accurate measure of the volume of the lesion is required. Magnetic resonance imaging is often used to detect stroke lesions, but it requires image segmentation. In order to segment the region where the lesion is located, unsupervised machine learning methods, like the Normalized Cut, can be used. We may use a-priori information to perform the Normalized Cut, namely, we can choose pixels in an image that are locked into a certain segment. This is a costly process for segmenting three-dimensional images because it must be done one slice at a time. To reduce the time of performing this task, we only select one pixel in each slice and automatically choose the rest of the points. Finally, we generate the three-dimensional image of the lesion, we compute its volume and the Dice similarity coefficient to measure its accuracy.

49R-U

Analyzing the Effectiveness of the Gang Reduction Youth Development Program using Dynamic Mode Decomposition

Axel Sanchez Moreno[1], Marc Andrew Choi[2], Siyu Huang[3], Hengyuan Qi[3], Marco Scialanga[3], Emerson McMullen[4], Andrea Bertozzi[3], P. Jeffery Brantingham[3], Yifei Lou[5]
[1]Texas State University, San Marcos, Texas, USA. [2]University of California, Los Angeles, Richardson, Texas, USA. [3]University of California, Los Angeles, Los Angeles, California, USA. [4]Harvey Mudd College, Claremont, California, USA. [5]University of Texas Dallas, Richardson, Texas, USA

Abstract

Dynamic Mode Decomposition (DMD) is applied on large data sets to assess the effectiveness of the Gang Reduction Youth Development (GRYD) Program. Aimed at reducing gang involvement in the city of Los Angeles, GRYD identifies eligible clients through the Youth Set Eligibility Tool (YSET) and provides services. The results of DMD applied on the YSET data sets confirm that GRYD is effective in reducing the risk of youth participants in joining gangs. We also perform DMD on each category of the questionnaires to investigate the GRYD's effectiveness on different personality traits that the questionnaire seeks to measure.

NATURAL RESOURCES AND CONSERVATION

50R-G

Resistance of grassland community productivity to nutrient addition and soil disturbances depends on the season.

Tilak Chaudhary[1], David W. Rowley[2,3], Philip A. Fay[2], Joseph W. Veldman[3], Jason P. Martina[1]
[1]Department of Biology, Texas State University, San Marcos, TX, USA. [2]Grassland Soil and Water Research Laboratory, ARS – USDA, Temple, TX, USA. [3]Department of Ecology and Conservation Biology, Texas A&M University, College Station, TX, USA

Abstract

Grassland covers about 40% of the total earth's land surface and provides many ecosystem services essential for human well-being. Global change drivers, such as land use change and nitrogen deposition, negatively affect grassland ecosystem functions. We used a Disturbance and Resources Across Global Grasslands (DRAGNet) site in Temple, TX USA to quantify aboveground grassland productivity resistance (Log Response Ratio (LRR) = log($Treatment_{Biomass}$ / $Control_{Biomass}$) to eutrophication and soil disturbance. LRR allows us to determine the sensitivity of a function (e.g., biomass production) to a perturbation (e.g., disturbance). DRAGNet consists of 25, 5 m x 5 m plots arranged in a Latin square design with the following treatments: (1) Control (C), (2) NPKμ, (3) disturbance (D), (4) NPKμ+D, and (5) NPKμ cessation. In the first year of treatment, aboveground productivity showed subtle resistance to treatments in the fall but not in spring. Species richness positively affected biomass resistance, while Johnsongrass abundance negatively affected the resistance. Species richness declined in disturbed and NPKμ+D plots, and the late growing season consistently had lower species richness. These results suggest aboveground grassland productivity resistance to eutrophication and disturbance depends on the season, but species richness shows an overall and immediate decline, and changes in species richness and Johnson grass biomass influence grassland productivity resistance.

51R-G

Remote Sensing of Invasive *Arundo donax* in Native Fish Conservation Areas of Texas

Jenna M DeMent[1], Jennifer Jensen[1], Monica McGarrity[2], Jason P Martina[1]
[1]Texas State University, San Marcos, Texas, USA. [2]Texas Parks and Wildlife Department, Austin, Texas, USA

Abstract

Invasive species management is hindered by delays in detection or knowledge gaps of species-specific expansion rates. When community monitoring is irregular, disturbed and even protected natural areas become more vulnerable to advanced invasions. Monitoring requires investment of time and labor that could otherwise be used on treatment. We aim to map the aggressive riparian invader, *Arundo donax*, in Native Fish Conservation Areas (NFCAs) of Texas. High resolution multi-spectral imagery was collected around known *Arundo donax* populations to isolate the species' unique spectral response. This response was then compared to satellite imagery for the development of a classification map encompassing the riparian zones of targeted NFCAs. Models indicate a spectral relationship between sensors, though accuracy assessment is underway. Mapped infestations and elucidated expansion rates of Arundo will be used in a spatial analysis investigating relationships between *Arundo's* spread and landscape characteristics. These results will be used in identification of priority management locations of *Arundo donax* and may aid in streamlining ongoing management efforts. Additionally, project products will benefit land management agencies through the creation of the first remote sensing based *Arundo* inventory in NFCAs and advised methodology for continued detection.

52R-G

Using ecological niche modeling to predict distributions of two endangered plant species, *Leavenworthia texana* and *Physaria pallida*

Brianna Fogel[1], Paula S Williamson[1], Adrian Castellanos[2], Jason P Martina[1]
[1]Texas State University, San Marcos, Texas, USA. [2]Cary Institute of Ecosystem Studies, Millbrook, New York, USA

Abstract

Leavenworthia texana and *Physaria pallida* are endangered wetland plant species found exclusively on the Weches glade in East Texas. These plants are under threat from invasive species, habitat loss and fragmentation, and climate change, with population numbers dwindling in recent decades. This research used a combination of simple mapping techniques and ecological niche modeling to predict species distributions and locate additional plant populations. For the simple mapping, basic habitat layers were overlapped with known population data to highlight areas of potential plant occurrence. For the ecological niche model, we used a combination of environmental variables pertinent to the species (such as soil characteristics, land cover data, and temperature and precipitation records) and known species occurrence records to determine locations that are mathematically predicted to be habitat areas of high suitability. We used the results from the simple mapping in Spring 2022 to check 19 sites for *P. pallida* and 15 sites for *L. texana*. Of the 15 sites visited for *L. texana*, 10 had potentially appropriate habitat, and of the 19 sites visited for *P. pallida*, 11 had potentially appropriate habitat. We were able to locate five populations of *Physaria pallida* and one population of *Leavenworthia texana*. Successfully keeping these endangered species from extinction relies on identifying areas that may warrant monitoring and protection. The ENM developed in this project will be used by government conservation agencies to inform real decision-making processes that will benefit both species and aid in their future recovery.

53R-G

Development of a Concurrent Community Science E. *coli* Bacteria and Optical Brightener Monitoring Prototype as a Pollution Screening Tool

Desiree A. Jackson[1,2], Sandra S. Arismendez[1,2]
[1]The Meadows Center for Water and the Environment, San Marcos, Texas, USA. [2]Texas State University, San Marcos, Texas, USA

Abstract

Lower Cypress Creek is an urban stream in Central Texas exhibiting signs of water quality degradation and often exceeds the E. *coli* bacteria water quality standard for contact recreational use. This is a concern due to the role ecotourism plays on the local economy and the way Cypress Creek is used for recreational activities. The purpose of this study was to monitor E. *coli* bacteria to identify potential sources of contamination, to conduct optical brightener "tampling" monitoring concurrently as a pollution screening tool, and to develop a state-wide community science prototype to serve as a warning system for wastewater contamination. Monitoring was conducted at eight sites from June 2021 to December 2022, with four data types produced: water-quality field parameters and observations, E. *coli* bacteria colony counts, "tampling" presence/absence, and optical brightener fluorescence. Results revealed a higher E. *coli* geometric mean downstream of the bridge crossing at Ranch Road 12 compared to upstream. The highest E. *coli* geometric mean was from the site downstream of the confluence of the Ozona Creek tributary that drains commercial and residential developments. Correlation analysis of rainfall and E. *coli* bacteria yielded strong positive correlations ($r^2 > 0.50$) at all sites except the site on Ozona Creek. The optical brightener "tampling" resulted in varying levels of fluorescence at all sites. These findings suggest potential sources of E. *coli* bacteria to lower Cypress Creek may include Mexican free-tailed bats, nonpoint source stormwater runoff, and failing or illicit discharges from on-site sewage facilities. Prototype development is ongoing.

54R-G

Tropical epiphytes as reservoirs for the amphibian-killing fungus

Maria Del Mar Moretta-Urdiales[1], Moises Tenorio[2], Francisco Velasquez[3], Ryan Lynch[2], Juan Manuel Guayasamin[3], Shawn McCracken[4], David Rodriguez[1]
[1]Texas State University, San Marcos, Texas, USA. [2]Third Millennium Alliance, Quito, Ecuador.
[3]Universidad San Francisco de Quito, Quito, Ecuador. [4]Texas A&M University – Corpus Christi, Corpus Christi, Texas, USA

Abstract

Batrachochytrium dendrobatidis (Bd) has been identified as a major threat to amphibian diversity. Previous studies have shown Bd is found in 28% of amphibians in a coastal Chocó region of Ecuador, which is Ecuador's most threatened rainforest, with just 2% of its original forest cover remaining. However, the life cycle of Bd includes an aquatic, flagellated, and free-living zoospore stage critical in initiating infection in amphibians. Therefore, it is necessary to also investigate potential Bd aquatic reservoirs. This study aimed to determine the role of bromeliads (Family Bromeliaceae) as water reservoirs in the prevalence of Bd on the landscape independent of the host. Our study was also conducted in the coastal Chocó region. We collected water from 120 bromeliads, and using a portable laboratory, we extracted environmental DNA and conducted quantitative PCR in duplicates. Results were examined and interpreted as positive (presence of Bd) and negative (absence of Bd). Out of the 120 samples, 11.6% tested positive for Bd [95% CI (0.06 - 0.22)]. We found that Bd is present in isolated water repositories suggesting that bromeliads are potentially helping to maintain Bd on the landscape even during the dry season.

55R-U

Using a simulation model to test the competitive dominance of two invasive wetland species

Andrew D Martinez, Jason Martina, Clementina Calvo Rocca
Texas State, San Marcos, Texas, USA

Abstract

In the Great Lakes region, wetlands are at risk of invasion by several non-native plant species. High nitrogen and phosphorus loading from the surrounding landscape is largely responsible for the success of non-native wetland species in this region. This project seeks to improve the realism of simulated invasions by including two invasive plant species frequently present in the same wetland, *Typha x glauca* and *Phragmites australis*. MONDRIAN is an individual-based computational model that simulates interactions between plants and environmental factors, including hydrology and nutrient loading. MONDRIAN has been used to model invasion dynamics and control methods, but there has been a lack of experiments simulating the coexistence and co-invasion of multiple invasive species. For this project, model runs were conducted at three nutrient levels, simulating low, medium, and high nutrient loading. Simulation runs were conducted with 1) only natives, 2) one invasive species with natives, and 3) both invasive species with natives, to investigate how competition outcomes depend on nutrient loading. While either invasive can dominate at high nutrient loading when invading alone, our results suggest that in a high-nutrient environment, *Phragmites australis* outcompetes the native community and the other invasive, *Typha x glauca*. In addition, there was not a significant difference between native plant productivity between high-nutrient runs where both invasives were present compared to runs where only *Phragmites* was present, though in both cases native productivity was low. We anticipate that these results will help to understand how nutrient availability influences invasion dynamics.

56R-U

Impact of Rising Temperatures and Increasing Nitrogen input on invasive *Phragmites australis* in Coastal Wetlands

Rebecca Nicole Villarreal[1], Trinity Vaquera[2]
[1]Texas State University, Schertz, Texas, USA. [2]Texas State University, Schertz, Tx, USA

Abstract

Phragmites australis is invasive to the coastal wetlands of the Great Lakes region and is capable of reducing biodiversity by outcompeting native plant species. *P. australis* is strongly influenced by nutrient availability, particularly nitrogen (N) and phosphorus (P), and has been shown to invade more quickly in high-nutrient environments. MONDRIAN is an individual-based computational model that simulates individual plants of multiple plant species and their interaction with various environmental factors (nutrients, hydrology, etc.). We used MONDRIAN and current climate projections for the Great Lakes region to explore the impact of increasing global temperatures and nitrogen levels on P. australis' invasion potential. To simulate climate change, we gradually increased temperature from 11.5℃ to 12.6℃ over a 40 year period, and compared it to a scenario with no temperature increase. We used 4 levels of N representing low, medium, high, and extreme nutrient input, which were crossed with the two temperature scenarios, as well as two optimum species-specific temperature ranges for *P. australis*. Our results show that invasion by P. australis is enhanced by both high N and increasing temperature, while in lower N conditions, rising temperature did not impact *P. australis'* growth. Our results suggest *P. australis* may be more invasive in a warming world.

PHYSICAL SCIENCES

57R-G

Characterization of Pt quantum dots fabricated by electron-beam induced deposition

Binod D.C., Noah Austin-Bingamon, Yoichi Miyahara
Texas State University, San Marcos, TX, USA

Abstract

We study Pt quantum dots (QDs) deposited by focused electron-beam induced deposition on atomic layer deposition (ALD) grown Al_2O_3 on Pt coated Si substrates, which finds potential applications in sensors, solar cells [1], and single-electron boxes. While the deposited dots are rich in carbon, the carbon content can be reduced by annealing the deposits in the oxygen environment [2]. The removal of the carbon from the dots is confirmed by the morphology studies and conductive atomic force microscopy (C-AFM) measurements before and after the annealing. The electron tunneling through the ALD grown Al_2O_3 between the dots and the Pt layer is then studied using the single-electron sensitive electrostatic force microscopy (e-EFM) technique [3]. We will present the tunneling rate and charging energy of the Pt QDs in the single-electron box configuration.

We gratefully acknowledge funding from NSF DMR-2122041, NSF DMR-2044920, and NSF DMR-2117438.

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58R-G

Magnetic Anisotropy and Particle Distribution through Strontium ferrite/PA-12 FFF 3D printer filament

Gabriela Lynnette Espinosa Rodriguez, Oluwasola Arigbabowo, Jitendra Tate, Wilhelmus Geerts
Texas State University, San Marcos, Texas, USA

Abstract

Strontium Ferrite (SF) is an important hard magnetic material with a ferrimagnetic structure which can be used for 3D printing of permanent magnets used in generators that convert mechanical energy to electrical energy. SF/PA-12 thermoplastic composite filaments were produced using a twin screw extruder. Magnetic SF powder was mixed with PA-12 polymer to create Fused Filament Fabrication (FFF) filament in which the PA-12 keeps together the SF particles. Although experimental data on the distribution of the magnetic particles through the filament does not exists yet, theoretical computational groups have determinated that upon extrusion the non-spherical SF platelets will arrange themselves with their long axis parallel to the filament's cylindrical axis. According to the calculations this alignment is stronger near the outer surface of the filament while no alignment is expected near the center of the filament. To support this theory our approach was to take samples of a small 1 mm long disk cut from a 40 wt% SF/PA-12 filament using a dissecting tool that could cut 0.5mm, 1.0 mm or 1.26 mm cylinders out of the composite. Then a biaxial Vibrational Sample Magnetometer (VSM) was used to obtain hysteresis graphs of the hollow cylinder, the core, and a pristine disk. The preliminary data shows that the material is anisotropic near the cylindrical outer surface and more isotropic or randomly orientated at the filament's core.

This work was supported in part by NSF through DMR- MRI Grant under awards 2216440 and in part by a DOD instrumentation grant (78810-W911NF-21-1-0253).

59R-G

Charge transfer through individual DNA molecules measured by mechanically detected electric charge sensing

Rigo Mayorga-Luna, Noah Austin-Bingamon, Binod D.C, Damilola Runsewe, Mitchell Ford, Tania Betancourt, Yoichi Miyahara
Texas State University, San Marcos, TX, USA

Abstract

Due to its programmable nature and rapid production, DNA has gained wide interest in being used in the advent of novel nano-scale devices, giving rise to the field of DNA nano-technology. One novel application, and of specific interest, is that of the use of DNA molecules as charge transfer mediums for molecular nano-electronic devices. For such devices to be of practical use, a thorough understanding of the electrical properties of the charge-transfer mechanics within the DNA molecule is required. Attempts at characterizing the electrical properties of individual DNA molecules have been previously performed, however, there still remains disagreement among the scientific community regarding the classification of DNA molecules. Thus far, DNA has been found to be a conductor, a super-conductor, semiconductor, and an insulator. These conflicting results can be reconciled due the use of different setups during each experiment, ranging from differing methods of physical contact to the misplacement of the probe and or the method of probing the DNA molecules in question. In order to avoid such issues, a standard non invasive and repeatable method is required characterize the DNA molecules. To do so, in our research, we attempt to characterize individual hybridized DNA molecules attached to gold via thiol linkers using a mechanical non-contact method. Silicon-Gold substrates are prepared on which DNA Self Assembled Monolayers are grown and later hybridized with Gold NP functionalized complementary DNA. The charge transfer through the DNA is then measured via AFM non-contact mechanical charge sensing by atomic force microscopy at cryogenic temperatures.

60R-G

The Nature of X-ray Sources in the Andromeda

Erika Marentes, Blagoy Rangelov
Texas State University, San Marcos, Texas, USA

Abstract

Using the Panchromatic Hubble Andromeda Treasury (PHAT) program and Chandra X-Ray Observatory, we have acquired archival data of the Andromeda Galaxy to study the properties of the X-ray sources, of which more than ~1/3 remain unclassified. We identified the optical counterparts of 1177 X-ray sources with 739 of them containing more than one. We present preliminary analysis of the archival data including color-magnitude diagrams, X-ray spectral analysis, and theoretical modeling that help us determine what these sources are.

61R-G

Frequency and damping noise of atomic force microscopy cantilevers with optomechanically modified quality factor at low temperature

Noah L Austin-Bingamon, Yoichi Miyahara, Binod D.C.
Texas State University, San Marcos, TX, USA

Abstract

Noise in the frequency and damping signals are key parameters in determining microscope performance in frequency modulation atomic force microscopy (FM-AFM). We present a study of noise in the frequency and damping signals of AFM cantilevers used in a low temperature FM-AFM system with fiber-optic interferometric sensing of the cantilever deflection [1]. Due to a strong optomechanical coupling between cantilever oscillation and the optical field, the quality (Q) factor and resonant frequency are both dependent on the optical cavity length (formed by the fiber-cantilever distance). A systematic experimental study was undertaken to determine cavity lengths with the best signal to noise ratio, as well as the influence of optomechanically enhanced Q factor on frequency shift and damping noise. An automated protocol was developed to scan the fiber cantilever distance and measure the Q factor, resonant frequency, and frequency noise at each position. A digital phase-locked loop based self-excitation system was used to drive the cantilever oscillation and measure the frequency and Q. Actuation of the cantilever oscillation was achieved via optical force [1]. The fiber position was scanned using a computer-controlled piezoelectric stick-slip motor. A python script was used to unify control of the system.

[1] Y. Miyahara et al., “Optical excitation of atomic force microscopy cantilever for accurate spectroscopic measurements”, EPJ tech. Instrum. 7:2 (2020).

62R-G

Post Growth Treatment to Improve Electrical Conduction and Physical Properties of Nanowires Deposited by Focused ElectronBeam Induced Deposition (FEBID)

Rajendra Rai, Ujjwal Dhakal, Binod D.C., Yoichi Miyahara
Texas State University, San Marcos, 78666, Texas, USA

Abstract

1. A single-electron transistor (SET) is a nanoelectonic device that works by the quantum mechanical tunneling of single electrons. While a SET has promising applications such as ultra-low power logic circuits and qubit readout, it requires a tiny nanometer scale metallic island to be quantum mechanically coupled to source and drain electrodes. Our goal is to fabricate a SET by directly writing the required structure (island, source and gate electrodes) with the focused electron-beam induced deposition (FEBID) of platinum on a pattern of gold microelectrode fabricated by photolithography. However, FEBID-deposited nanoelectrodes offer high resistance because these deposited structures are mixed with unwanted precursor elements like carbon due to its precursor Me3CpMePt(IV), (where, Me: methyl, Cp: cyclopentadienyl). We investigate the techniques to get the most purified electrodes [2]. We explore different techniques to purify these deposits and improve the physical and electrical properties of those nanoelectrodes. Post-growth purification processes using electron irradiation, irradiation in presence of the atmosphere, or using pulsed oxygen supply at a temperature 150C, irradiation in an H2O atmosphere are found to be effective in purifying the deposits and improving thereof mentioned properties of the nanostructures [3].

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63R-U

Photothermally Responsive Dynamic Hydrogels Incorporating Reversible Thiol/Ene and Irreversible Maleimide/Thiol Crosslinking for Pulsatile Drug Delivery

Edgar Torres[1], Kushal Thapa[2], Thomas FitzSimons[3], Mckenzie Siller[1], Joanna Zepeda[1], Adrianne M Rosales[3], Tania Betancourt[1,2]
[1]Department of Chemistry and Biochemistry, Texas State University, San Marcos, TX, USA. [2]Materials Science, Engineering and Commercialization Program, Texas State University, San Marcos, TX, USA. [3]McKetta Department of Chemical Engineering, The University of Texas at Austin, Austin, TX, USA

Abstract

Hydrogels are three-dimensional hydrophilic polymer networks with tissue-like properties that have been used in biomedical applications for several decades. In our laboratory, a pulsatile drug delivery system based on dynamic poly(ethyleneglycol) (PEG) hydrogels crosslinked via thiol/ene Michael addition was previously explored. These hydrogels were designed to be photothermally activated upon irradiation of embedded poly(ethylenedioxythiophene) (PEDOT) nanoparticles. While showing great promise, the dynamic nature of the crosslinks of these hydrogels led to the uncontrolled hydrogel dissolution and consequent release of entrapped agents when no stimulation was applied when in an unconstrained aqueous environment. In this work, 4-arm-PEG-Maleimide (PEG-Mal) is investigated as a potential solution providing a secondary crosslink to contain the unwanted release. To synthesize the hydrogel, a Michael addition of thiol-ene functional four-arm PEG-benzylcyanoacetamide, PEG-thiol, and PEG-Mal was conducted. Various molar ratios of the three precursors were explored. The hydrogel was loaded with PEDOT nanoparticles to provide it with photothermal properties, and BSA-FITC, a fluorescently labeled protein, acted as a therapeutic mimic. The release of BSA-FITC upon application of heat or laser irradiation of the hydrogels was confirmed visually and spectroscopically. Results showed that no undesired release of BSA-FITC occurred from hydrogels that included PEG-Mal, in contrast to those lacking these stable crosslinks. Further studies will be carried out to verify the addition of PEG-Mal as a viable option for the preparation of hydrogels for the pulsatile release of therapeutic agents.

64R-G

Rapid slot-die coating of high-quality absorber thin films by optimizing DMF/DMSO solvent ratio of triple halide perovskites

Nischal Khakurel[1], Wilhelmus Geerts[1,2], Yoichi Miyahara[1,2]
[1]Material Science, Engineering and Commercialization, Texas State University, San Marcos, TX, USA.
[2]Department of Physics, Texas State University, San Marcos, TX, USA

Abstract

Hybrid halide perovskite solar cells have emerged as a promising candidate for next generation solar panels due to their high efficiency and low cost. However, current laboratory-scale deposition method, spin coating is not scalable for commercial production of larger panels. Gas quenching assisted slot-die coating has been proposed as a promising alternative, but the coating speeds reported in literature are not fast enough for large-scale production.

In this work, we demonstrate a novel approach to increase the coating speed by adjusting the ratio of DMF/DMSO used in the hybrid perovskite solution. By changing the vapor pressure of the ink, we can significantly increase the coating speed of gas assisted slot-die coating, up to 40mm/s. This corresponds to coating speed of 700 M10 wafers per hour using a slot-die printer such as the nTact nRad Research and Development Printer.

The film thickness grain size and crystal structure is measured for different DMF/DMSO solvent ratios in the ink. SEM and AFM images are taken to determine the film quality. Device performance is measured on small 1x1” device wafers.

This work was supported by NSF through STTR Phase II grant (1927020) and the US DOE-EERE under the Solar Energy Technologies Office Award (DE-EE0009526).

65R-G

Fabrication of nanopores by tip-controlled local electric breakdown

Johnathan E Sims
Texas State University, San Marcos, TX, USA

Abstract

Nanopores are nanometer-sized channels (several nm to several ten nm) created in nanometer-thick membranes and have promising applications. One of the most exciting applications is next-generation DNA/protein sequencing. Different techniques have emerged to create nanopores including focused electron/ion beam etching, however both techniques require the use of electron microscopes which add cost and complexity to the fabrication process. While it is known that dielectric breakdown across the membrane immersed in an electrolytic liquid, can produce nanopores their location is unpredictable because it is determined by random inhomogeneities in the membrane. A new technique using tip-controlled local breakdown has been proven to provide both precision in location and reproducibility of dimensions all while not requiring expensive equipment to produce. To further this research, there needs to be an apparatus to easily produce nano size pores within a membrane so that the resulting nanopores can be transferred and used in other experiments. This work aims to develop such an apparatus and establish the procedure to create nanopores within a silicon nitride (SiNx) membrane using voltage controlled local breakdown (TCLB), in which a sequence of pulse voltages is applied across the SiNx membrane between a conductive Atomic Force Microscope (AFM) tip operated in contact mode and a conductive electrolyte liquid.

SCIENCE TECHNOLOGIES

66R-G

Magnetic Torque Measurement of a 3D printed Strontium Ferrite Sample

Arjun Sapkota, Leo Rodriguez, Wilhelmus Geerts, Jitendra Tate
Texas State University, San Marcos, Texas, USA

Abstract

Magnetic anisotropy (K_2) is a basic and crucial property for the characterization of magnetic materials. Torque measurements (TM) are used to measure a sample's K_2 and can be taken using a torque magnetometer or indirectly using a vibrating sample magnetometer (VSM) [1]. In this research, the magnetic torque of a strontium ferrite 3D printed sample created using Magnetic Field Assisted Additive Manufacturing (MFAAM) [2] was explored using a VSM. Torque-curves were taken from 16-22kOe every 2kOe using a 1 mm long sample attached to an 8 mm circular cover glass and mounted on a perpendicular sample holder. Fourier analysis was used to determine second harmonics from each torque-curve. K_2 was determined from the y-intersect of the second harmonic vs 1/H graphs. Torque curves changed with the orientations of the sample revealing a complex anisotropy axis distribution. The easy axis is not perpendicular to the print bed or parallel to the print direction but tilted. It was noticed that the torque curves contain a 2^{nd} harmonics background caused by non- perfect alignment of the sample on the sample-rod or the sample-rod in the vibration shaft.

This work was supported in part by NSF through DMR- MRI Grant under awards 2216440 and in part by DOD instrumentation grant (78810-W911NF-21-1-0253).

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[2] Tanjina Ahmed. Ph.D. dissertation, Texas State University, February 2023.

STEM EDUCATION

67R-G

Outdoor Science Activities Allow Children to Explore STEM Practices and the Natural World in an Engaging Setting

Carolyn A Jess, Raylee K Schobel, Kristy L Daniel
Texas State University, San Marcos, Texas, USA

Abstract

Today's youth lack opportunities to participate in science practices outdoors. The purpose of this study was to capture fifth-grade student responses to an outdoor science activity booklet, Pollination Partners, to discover what benefits the students received from the activity. The booklet contained four post-activity questions to find what each student found most enjoyable, important, helpful, and what aspects made the participants feel most like a scientist. Student responses were inductively coded and organized into categories and themes to reveal that students most enjoyed taking part in outdoor science practices. Participants reported that nature-related science content and environmental mindfulness were the most important elements they learned. Learning was best supported by a guiding activity book, exploring human interactions within pollination systems, reading and personally experiencing the subject matter, and emphasizing patience and collaboration. Students felt like scientists when we provided them with the opportunity to engage in science practices, interpret visual data, and complete field-based activities. Short outdoor activities, such as Pollinating Partners, promote children's scientific interest and identity development. Using what we learned through inductively coding student responses, we can implement tools children found beneficial into future science activities to ensure participants experience enjoyment, learning, and feeling like a scientist.

68R-G

Examining student thinking about series approximations using potential energy in a series of charge configurations

Samuel F Zamora, Hunter G Close
Texas State University, San Marcos, TX, USA

Abstract

Series approximations are a critical concept in mathematical physics, and its applications across a wide range of topics make it a vital tool for physicists. Despite this, little has been documented on student thinking when learning to apply approximations. Introduction to Mathematical Physics is a junior level undergraduate course offered at Texas State University where students engage with series approximations in familiar physical conditions. We are developing an artifact to explore student reasoning related to series approximations. Our instruction sequence begins with students analyzing simple cases of double point charge configurations and then leads into a guided written activity of approximating electric potential energy of a test charge between two coaxial rings of like charge. We have learned that some students are hesitant to take certain physical limits and struggle to relate these to mathematical formalism. We have also observed students using productive cognitive resources involving rolling marbles when thinking about stability.

69R-U

Developing Trust: Assessing biology Learning Assistant-faculty partnerships in the STEM Communities Project

Hannah Castro, Lexie Kerr
Texas State University, San Marcos, Texas, USA

Abstract

The STEM Communities Learning Assistant Program aims to implement Learning Assistants into STEM courses for a more enriching environment. We are constantly working to improve the STEM Communities Initiative to provide the students, LA's and Faculty with the best experience we can provide. Interviews with faculty and LA's are one method utilized to obtain feedback on the program. While investigating the benefits and limitations of the Learning Assistant Program, one key experience for most LA's was identified as the relationships they form with faculty. In this poster we will analyze and discuss possible benefits and challenges LA's face when working with faculty on course redesigns.

70R-G

Exploring undergraduate students' difficulties of interpretations on tree thinking approach using eye movements

Mallika Saha, Kristy L Daniel
Texas State University, San Marcos, Texas, USA

Abstract

Evolutionary biologists view biology through the perspective of phylogeny or evolutionary history. Biologists use phylogenetic representation to explain evolutionary relationships. These representations give a broader explanation of how species are interlinked and interconnected with each other. Phylogenetic tree is one of the core forms of representation that shows the evolutionary relationship among species groups. Tree thinking is the ability to correctly understand, use and generate phylogenetic trees. Not only is the ability of tree thinking necessary for understanding evolution, but it is also useful for understanding agriculture, biotechnology, climate change, forensics, and health. However, studies showed that students are facing difficulties to interpret trees correctly. The purpose of this study is to analyze the eye movement patterns of students to figure out how students are reading trees and where they are struggling to interpret those. In this study, an eye-tracker is used to capture participants' eye movements while solving tree thinking problems. By analyzing these eye movements, we figured out, the difference in eye movement patterns between the students who answered those correctly and the students who answered incorrectly, what are the distracting areas when solving the tree reading problems, and how much time they are spending on those distracting areas.

Design Poster Presentations

71D-G

Huffmanela cf. Huffman infecting swim bladder of variable platyfish and Gambusia holbrooki (Poeciliidae) in Texas; taxonomy, phylogenetic analysis, and pathological changes.

Meraj Fallah Abed
Texas state university, San Marcos, Texas, USA

Abstract

Variable Gambusia geiseri fish from the San Marcos River in Texas were tested for parasitic Huffmanela cf. Huffman infections. We looked at the eggs, which were identified as parasites infecting the part of the fish body. Species of the category of parasites, which previously seemed to be host specific at the fish-family level, affect two fish families from two through taxonomy and different orders with a disease. This study was conducted in the Summer of 2022 Texas. We tested 864 types of fish and planned a test of the aim involving an example of some fish from a reach of the river, where the outbreak of parasites. That fish is a species local to the river and is very common in that same reach where parasites and close to the G. holbrooki of the parasites. The study is the record of water which is fresh species of parasite from the river and the first evidence that no infection by a parasite causes changes that could impact the part of the fish body. Study of disease changes part of the body in low-strength infections in addition to tissue death in high-strength infections. None of the types of fish were infected.

72D

Fire-Bot Enhancements

Timothy T Maraj, Benjamin Swann, Oscar Resendiz, Tony Alebesun
Texas State University, San Marcos, TX, USA

Abstract

Fire-Bot is a design project with the intention to create an autonomous robot capable of traversing a burning building, detecting victims in need of rescue by using machine learning models for scream and person detection, and displaying environmental data it collects inside. This rover could aid firefighters by providing faster person detection and building mapping. These two critical functions will cut down the time needed to locate victims, reducing the time all parties spend in hazardous environments.

The design team has implemented these features with the following hardware and software. Autonomous navigation and mapping rely on a Slamtec RPLiDAR module and Intel Realsense Depth Camera for object detection. The machine learning models, motor control, and peripherals are synchronized using Jetson Nanos which provide both CPU and GPU capabilities. The GPU is used to optimize the ML models for better inference time, leading to faster person detection. Lastly, the user interface has been implemented with web development languages and frameworks such as HTML, CSS, Javascript, Python, and Flask. However, the bridging of data from the rover to the site is done through InfluxDb, a real-time cloud database service.

In conclusion, this design project provides a tool that could be used to aid in search and rescue operations by combining advanced sensors, autonomous navigation, and machine learning. The completion of this prototype will allow for better designs to be created leading up to a robot with improved efficiency and traversal capability of field deployment.

73D

HDPE Post Consumer Plastic Mold Designs

Ryan Robinson, Drew Lacy, Korbyn Jones, Robert Leija, Jose Guerrero
Texas State University, San Marcos

Abstract

With an abundance of plastic that has been discarded by the consumer, there is a market and political pressure to recycle an increasing amount of it. Small-scale recycling of custom products by consumers has been the focus of this project, as well as drawing consumers to the Ingram Hall Makerspace to learn about engineering and manufacturing. Research was conducted about general plastic die design and gradually focused on compression molding and using post-consumed high-density polyethylene (HDPE or #2 plastic) as our raw material. The result will be five individual molds that will have unique designs, and market appeal for people with no affiliation to be drawn into the Ingram Hall Makerspace. Blending different plastic colors together makes every product unique and highly customized to the individual. This will create a sense of buy-in with the consumer and lead to repeated usage and product promotion through word of mouth.

74D

Ergonomics Bobcat Racing Team

Allan A Alvarez[1], Sean Wilhite[2], Victor Hernandez[1], Christopher Lamos[1]
[1]Texas State University, San Marcos, Tx, USA. [2]Texas State University, San Marcos

Abstract

The main objective for this project is to design and analyze an effective and practical pedal box for the 2023 Formula SAE (FSAE) car by refining the parameters for the pedal box measurements, pedal constraint, pedal ratio, input force, and ergonomic conception. The pedal box assembly is the most crucial part of the vehicle because the driver directly interacts with the system and makes the ergonomics considerations lucrative to the success of the project. This scope of the research includes the material selection, manufacturing process, and stress-strain analysis without infringing any FSAE design specification rules. The computations of the pedal ratio and pedal constraint angle were done using Solidworks and later used Microsoft Excel to chart our calculations and decide a final geometry. The production and manufacturing process shall be done in MasterCam demonstrating the necessary tool-paths and executing the needed assembly of the pedal box assembly.

75D

New Braunfels Heritage Tribute

Deborah L Jauregui, Bianca A Chernoff, Devyn M Grant, Mikayla McAweeney
Texas State University, San Marcos, TX, USA

Abstract

This project represents a tribute to the history and culture of The City of New Braunfels. The Miniature Golf Course located in New Braunfels, Texas is one of the multiple attractions in Landa Park. During its season, the 18-hole miniature golf course experiences a high volume of customers, unpredictable conditions: including extreme bending, weight, and weather conditions. Minimal to no maintenance for 10 years and durability for over 20 years is required.

Three features representing The Main Plaza Bandstand, The Faust Bridge, and The Founders' Oak were selected. Currently, a bandstand is installed on the selected hole but has deteriorated into a non-salvageable state. The Main Plaza Bandstand symbolizes the importance of music and community to the history of the city and is a Texas Historic Landmark. Due to its importance, replacing the feature is ideal. To create the distinguishable bell-shaped roof, the feature was manufactured through metal-casting and powder coated.

To accomplish engaging while accurate features different processes were used, due to their unique designs. Used over 300 years ago as a form of communication by Native Americans, The Founders' Oak Tree is also a landmark and known as The Famous Tree of Texas. The waterjet was used to create the branch it is known for, and golf balls added as an appealing, aesthetic detail. The Faust Bridge, one of the last remaining Whipple roadway trusses in Texas, and last in its original site, was also water-jetted to fabricate the appreciable combination of the Whipple and Pratt designs.