2022 Research Symposium Poster Overviews:

Alexander Adogwa

Development of Magnetic Induction Heating Catalysts with Atomic Precision for Clean Energy Applications

Thermal energy, also known as the heat, is perhaps the most widely utilized form of energy to trigger various chemical reactions. For catalytic reactions, the thermal energy is only needed at catalytic sites that are often in the size range of sub-nm scale, but in real-world operation the entire reactor with magnitudes larger sizes (in ft or m) must be heated up to host the catalysts. Practices as such bear significant energy loss at the system level no matter how efficient the actual catalysts are. Alternatively, if local heat can be generated on the catalytic nanoparticles to catalyze reactions, then the current needs for external heating resources and their associated energy loss can be circumvented to a great extent. My research project centers around the magnetic induction catalysis, which exploits the "self-heating" properties of ferric oxide-based catalysts due to their magnetic anisotropy under alternating magnetic induction fields. As the world advocates sustainable energy, we are searching for catalytic materials that can simultaneously serve as good self-heating agents and effective catalysts for CO2 reduction and fuel-cell reactions, where conventional furnace is otherwise a must for initiating the reaction. A few vignettes of how we design and synthesize supported atomic species on the ferric oxide to improve catalytic performances will be discussed through this opportunity.

Allison Traylor

Next Generation Teams: Developing an Experimental Paradigm to Study the Future of Army Teams

This poster will provide an overview of our work, supported by the Army Research Institute, to develop an experimental paradigm investigating team dynamics in a military setting. Through this work, our team has generated a novel approach to collecting data on team dynamics including a high-fidelity, adaptable, core experimental paradigm as well as an innovative measurement and statistical toolkit including video and audio recordings, traditional survey data, observational data, and geospatial data. Our poster will provide an overview of the experimental paradigm, initial results generated from our work, and future directions for the paradigm.

Anna Morrison

Examining Factors Related to Teacher Efficacy for Online Teaching and Learning

This study examined factors related to teacher motivation for online teaching and learning, specifically focusing on teacher efficacy for teaching online.

Cristina Tica

geoFOR: A Clemson-led forensic anthropology initiative aimed to improve the medicolegal practitioner's toolkit for death scene investigations

Supported by an award from the National Institute of Justice, this project's goal is to improve methods for determining the postmortem interval (PMI) when human remains are found. Determining time since death for a decedent is one of the most critical pieces of information coroners and medical examiners grapple with. An accurate determination of PMI can facilitate the

identification of an unknown individual and help reconstruct the events around the time of death. A major weakness with the current state of the research is the lack of a reference dataset with a large number of cases from which research questions regarding factors impacting the rate of decomposition can be addressed. This poster will be used to demonstrate an application that can be used by practitioners using crowdsourced data to collect information from death scenes. This research utilizes a spatially coded, geographic information system (GIS) application that is accessible from mobile phones and tablets, among other devices. Forensic investigators working on a case use the app to record basic scoring information on the state of decomposition, and the GIS software records the location of the discovery. The application is available for use by investigators from across the country and internationally to develop a large reference sample; with a representative dataset, more innovative types of analysis will be possible, such as machine learning algorithms applicable to large datasets. Building collaborative networks with coroners and medical examiners across the state and across the county has helped us refine the format of the app, and helped us include observations practitioners make in the field, so this robust reference dataset could better represent forensic cases.

Daniel Moore

Evolving Microstructures in Additive Manufacturing: Insights from mesoscale modeling frameworks

Recent advances in laser-powder-bed-fusion (LPBF) have revealed considerable variations in materials microstructures as a function of the metal additive manufacturing (AM) laser beam profile. Such observations suggest the use of laser beam shape strategy to control local temperature gradients. However, a fundamental understanding of how laser beam shapes influence the formation and evolution of solidification microstructures is lacking. Here, we present theoretical and computational studies exploring the impact of laser beam profiles on the local temperature gradients and microstructures.

Deepak Sapkota

Thin film study of barium titanate

Barium titanate (BTO) has the highest dielectric constant among the perovskite ceramics with a high ferroelectric transition temperature. The thin film of barium titanate can be used in a wide range of technological applications ranging from the sensor to future quantum computing devices. Here, we present the systematic study of the barium titanate thin-film grown by the pulsed laser deposition method. Our study includes structural properties, surface morphology, and electrical characterization of BTO.

Delaney O'Tuel

Analysis of National Media Headlines and Kyrie Irving’s Decision to Skip the Jab

Kyrie Irving’s decision to remain unvaccinated is highly debated by sport fans, individuals of different races, and political affiliations. However, Irving continues to be an elite professional basketball player in the National Basketball Association (NBA), and with this comes continued media coverage of his decision to skip the jab. As a country, the United States’ feelings on what is, and what is not, considered ethical autonomy is strained, however Irving’s decision to avoid the COVID-19 vaccination has additional impacts on fans, youth, organizations, and race. Through the foundation of media framing, this paper aims to review and code via grounded theory, the major

episodic and thematic genres the media has highlighted through three significant time periods of the Kyrie Irving saga – his decision to remain unvaccinated, the Net's rule change to allow him to play in away games based on New York State law, and finally his return to play.

Emily Howell

Reciprocal Engagement of Caregivers of English Learners

The authors will conduct a comprehensive literature review of school district partnerships with caregivers of English Learners. This approach reflects a social cognitive perspective. The social cognitive view of learning is based on three reciprocal features: a person, their behavior, and the environment (Schunk, 2020). Much second language research views language learning as a purely cognitive function; however, Atkinson (2002) encourages more research the connects the cognitive and social development of second language learning. Both teacher and student caregivers are important members of this interaction and in need of study.
We will use the findings from this comprehensive literature review to analyze how they will inform the caregiver course in this grant and the potential of these findings in other contexts. As language is both a cognitive and social process of development, ELs need support both at school from their teachers, but also at home from the caregivers. EL caregivers often want to be more involved in their students' education, but feel excluded (Quiocho & Daoud, 2006). This desire is often neglected due to teacher and administrative misconceptions that these caregivers do not want to be involved. In addition, caregiver involvement can be limited due to challenges such as language barriers, time limitations, work schedules, etc. (PIQE, 2019). This literature review will address these gaps as well as the following research question: How can school districts build reciprocal engagement with caregivers of English Learners?

Ewa (Richard) Chukwu

Site Density of the Atomically Dispersed Pt Species Determines Intrinsic Activity of Pt1/MoxC for the Low-Temperature Reverse Water Shift Reaction

Single-atom catalysts (SACs) can maximize the atom efficiency of the supported metal species for various reactions. When the supported metal species can indeed catalyze the targeted reaction actively and selectively, one would often expect that increasing the surface population of such supported metal species on the given catalyst support would naturally enhance the overall reactivity, while the turnover frequency (TOFs) from each supported metal atom stays unchanged due to the single-atom nature. Here, through our investigation of the Pt/MoxC catalysts and with reverse water gas shift reaction (rWGS) as probe reaction, we report a pitfall of hosting high density of atomic Pt species even when its stability against sintering is not a concern. By tuning the Pt loadings (0.1 to 1.0 wt.%) on high-surface-area MoxC nanorods, we developed a group of catalysts with similar coordination environment and electronic states for the single-atom Pt but varying surface density. These catalysts are all several magnitudes more active than the benchmark Pt/CeO2 and Pt/TiO2 catalysts. More intriguingly, the TOFs of the Pt/MoxC catalysts varied inversely with the Pt atomic site density, with the 0.1 and 0.5 wt.% Pt as the key thresholds. At higher Pt site densities, the activation entropy offsets the benefit of lower activation energy and enthalpy. The more capable Pt catalytic centers at the Pt-MoxC interface,

display the capability to extract O from CO2 to form Pt2+-O, which can be subsequently consumed by the activated H from Pt. The rate order with respect to CO2 increased with atomic site density, signaling a decline in CO2 surface coverage. We believe that these indispensable interfacial sites drop with increase in atomic Pt density, leading to loss of degree of freedom, limited sites access by and tighter confinement of reacting species, resulting in entropic penalties manifesting in TOFs disparities. In summary, when catalytically active materials are employed as catalyst supports for single-atom
catalysts, we believe the surface site density of the supported atoms needs careful evaluation to avoid the scenario where the supported metal becomes overly crowded to gain access to the reaction intermediates supplied from highly active catalyst supports.

Junior Langa

Engineering Niobium-Germanium Interfaces for Voltage-Tunable Quantum Devices

Voltage-tunable hybrid superconductor-semiconductor Josephson junctions have recently emerged as promising building blocks for low-loss frequency-tunable quantum devices such as qubits, couplers, and magnetic flux sensors. The realization of hybrid devices in group IV semiconductors such as Si and Ge is of particular interest due to higher scalability and low dielectric loss at microwave frequencies. However, inducing superconductivity in Si and Ge via proximity effect has been proven to be challenging so far because of large interfacial energy barriers and defect densities. Here, we utilize molecular beam epitaxy to engineer the energy bands at Nb-Ge interfaces. By creating a gradient in Nb:Ga ratio throughout the superconducting layers, we create smooth potential gradients at the interfaces. Various thermal cycling schemes under vacuum and in inert atmospheres are used for tuning the interface structures. Using high-resolution transmission electron microscopy we determine the competing secondary phases that may form in the stacks. This is complemented by cryogenic magneto-transport measurements on the resulting Nb/Ge heterostructures (as films and Josephson junctions) where critical physical parameters including the induced gap size, the critical magnetic field, and the normal coherence length for the proximitized phases are determined.

Leah Holcomb

Managing Abstinence in Newborns 2.0 Expansion Hospital Perspectives at Baseline

This project examines facilitators and barriers to the successful implementation of the Managing Abstinence in Newborns (MAiN) program at several hospitals throughout South Carolina, guided by the Consolidated Framework for Implementation Research (CFIR)

Longxiang Guo

Multimodal-AI based Roadway Hazard Identification and Warning using Onboard Smartphones with Cloud-based Fusion

Ensuring the safety of both manned and automated transportation systems requires comprehensive situational awareness, and one critical part of it is identifying potential road hazards. Sharing such

information with other vehicles supports enhanced driver warnings as well as anticipative automated control. Roadway hazards could be caused by the roadway environment and potential obstacles. The former includes poor pavement conditions and bad weather, the latter includes roadwork, accidents, dead animals, and other unexpected obstacles. Traditionally, monitoring of pavement conditions requires many human and equipment efforts, which can still hardly provide timely needed information of road conditions. Meanwhile, detection of other road hazards heavily relies on proper sensor suite, which is not equipped by many existing vehicles. Even for those vehicles that do have capable sensor suites installed, they currently do not have the functions of identifying and sharing information of roadway hazards. Therefore, we propose a more cost-effective approach to identify roadway hazards by cloud-based collaborative monitoring using in-vehicle smartphones from any public vehicle user.
In this project, we propose to use a multi-modal-multi-output deep learning model to identify the type of roadway hazards as well as estimate its threat level based on data collected by in-vehicle smartphones. The first mode of the deep learning model is detecting roadway hazards and their threat level using motion data. When a vehicle drives over pavement defects such as potholes, or small obstacles such as dead animals, the acceleration signal, especially the vertical acceleration, will have a unique pattern in the trajectory. In this project, we propose to use multi-output Long Short-Term Memory (LSTM) based deep learning network to complete the identification of defect types of hazards and estimation of their threat levels at the same time. However, motion-based mode requires the vehicle to drive through roadway hazards, which however cannot be always guaranteed. In addition, the motion-based approach is subject to noise due to the dynamics of the vehicle and sometimes the acceleration may be filtered by the suspension. Thus, the second mode of the deep learning model, detecting and identifying hazards from the live video taken by the smartphone's camera using Region-based Convolutional Network (R-CNN) is added. The R-CNN will be integrated with the LSTM by ensemble layers to form a multi-modal-multi-output network structure. The complete framework has two channels for vision and motion inputs respectively, and two outputs for hazard type and threat level respectively.
We propose to fuse the roadway hazard detection results from different smartphones of multiple vehicles on a cloud server. Each identification and estimation result will form a discrete probabilistic distribution that is associated with a certain location of the road map. We then propose to aggregate all probability distributions within one road segment to form combined distributions. In the end, we expect to have a road condition map to show the locations of roadway hazards and their threat levels.

Lu Zhang

Rate and Predictors of Lung Cancer Screening Utilization in a Large Health System in South Carolina

Lung cancer screening can reduce lung cancer mortality for 20%, however, the utlization of lung cancer screening is still low. We examined the rate and predictors of lung cancer screening in Prisma Health patient population.

Maher Algalayini

Adaptively Optimizing Variable Additive Manufacturing Processes Using Machine Learning

In recent years, additive manufacturing (AM) techniques have received considerable attention for its ability to fabricate a wide range of materials types with complex geometries. However, the variability in the mechanical properties of printed materials remains one of the glaring challenges facing AM technologies. In this study, we develop a sequential design method that implements machine learning techniques to integrate variability and uncertainty in the analysis and optimization of AM process parameters. The proposed approach allows for the learning from previously tested points to adaptively choose the next design sites resulting in maximum information gain. The novelty of our approach lies in its ability to use Utility Theory to define the optimization criteria, and to implement statistical tools to identify a flexible number of design sites and samples to be tested. Method performance is tested on synthetic data. This study is expected to result in a novel efficient sequential method that optimizes variable and uncertain AM processes.

Omar Hussein

Morphological instabilities of nanoscale structures

Recent advances in high-precision manufacturing and self-assembly techniques have enabled the fabrication of three-dimensional materials architectures with intricate nanoscale features, including nanolattices, nanorods, and nanowires. However, the microstructural stability of such nanoscale features under externally applied fields remains poorly understood. Experimental findings have revealed a morphological instability, in which polycrystalline nanoscale rods/ligaments break up into spatially isolated structures; a behavior that is reminiscent of the Plateau-Rayleigh instability observed in liquids. Here, we present a theoretical and computational model to investigate the mechanisms controlling such pinch-off instabilities in polycrystalline nanoscale solids. An analytical model is used to derive a stability surface in terms of grain boundary and free surface energies, which demarcates stable and unstable perturbations. Computational studies are used to reveal self-similar scaling describing the critical time to pinch-off. In broad terms, our results show that the thermodynamic and kinetic aspects of this nanoscale instability in solids are mechanistically different from the well-celebrated Plateau-Rayleigh model.

Prasanna Valavanur Shekar

Investigate the use of nucleic acid molecules to manage pests and pathogens in crop plants

Sugarcane aphids' (Melanphis sacchari) outbreak in sorghum mainly affects crop production across the country by causing damage to the plant, mainly by nutrient withdrawal or passively decreasing photosynthesis, causing a great loss to the farmers. Similarly, Armillaria root rot, also referred to as oak root rot, is one of the major causes for the decline in peach (Prunus persica) production in the southeastern United States caused by Armillaria mellea and Armillaria tabescens. The management practices in both cases are the use of synthetic pesticides, mechanical removal, and scouting, which are unsustainable practices. The use of nucleic acids as pesticides using RNA interface (RNAi) strategy will help in sustainable management of crop protection as the repeated application of synthetic pesticides over the years results in the resistance development in pests and pathogens. The mechanism of RNAi is explored in insects and plants; the research has also been done in exploiting the mechanism in pathogenic fungi and insects to suppress the gene expression through Host-Induced Gene Silencing, Spray-Induced Gene Silencing, or cross-kingdom communication. Our study investigates the efficiency of small nucleic acid molecules in targeting

the vital pest/pathogen genes and determines the efficiency of different gene delivery methods in preventing precocious degradation of small nucleic acid molecules. We also evaluate the use of recombinant tomato yellow curl virus (TYLCV) as a source to induce resistance against Armillaria root pathogen through virus-mediated delivery and production of the double-stranded RNA (dsRNA), which will serve as a vaccine against the fungal pathogen.

Pravin Nath

Addressing Supply Chain Vulnerabilities for South Carolina's Aquaculture Industry: An Assessment of Preferences for Direct-to-Consumer Marketing of Shellfish Using Conjoint Analysis

The recent COVID-19 pandemic has created an impetus among various industries to consider alternatives to their existing avenues of sales. For the aquaculture industry, the impact of COVID-19 has been particularly severe given their reliance on tourism and restaurants. This emphasized a need to explore other avenues of selling aquaculture and mariculture seafood products beyond the typical restaurant supply chain. To that end, this project is investigating consumer preferences for at-home seafood consumption to identify and assess potential marketing opportunities for South Carolina shellfish, with a focus on selling oysters, clams, crab, and shrimp direct-to-consumer. It is based on a grant awarded by the South Carolina Sea Grant Consortium to Clemson University Marketing Faculty and involves MBA students. Through three phases, the research team is 1) ascertaining the motivations, concerns, and expectations of the shellfish farmer in South Carolina through key informant interviews; 2) measuring the beliefs, attitudes, and behaviors of consumers in and around South Carolina through consumer surveys; and 3) determining consumer preferences and willingness to pay for specific offerings of South Carolina seafood products.

Reagan Ross

Building Community, Searching for the Meaning of Life: The Construction of a Community Garden in a Small Southern Town

This poster presentation investigates the motivations and strategies of local residents who have actively engaged in the construction of a community garden in a small railroad town in South Carolina. Run by a community-driven foundation dedicated to improving local health, this garden has the following characteristics: it is located in a rural area while most community gardens studied by researchers are urban gardens, its volunteer force consists primarily of white retirees, and its origins lie within religion and medicine. By examining how local volunteers drive the projects forward and what motivates their continued participation, I argue that, for the volunteers that comprise its executive board and those that participate in its day-to-day maintenance, their main driver is a search for the meaning of life. These individuals use this garden as a route to find a sense of clarity, belonging, and purpose. Such motivator is a driving force for their individually continued work, but also of the success of the garden. Research on community gardens has been expanding in recent years. The study of this particular community garden in South Carolina will add to the understanding of the diversity of community gardens in the US. As concerns over how to achieve success within a community garden has grown, this research will provide empirical data for scholars and community activists to reflect upon the limitation and strengthens of different types of community gardens. Data collection for this project has been conducted primarily through ethnographic fieldwork, during which I used the methods of participant observation, in-depth interviews, documentary research, and electronic surveys to collect data. This poster presentation

is part of the research result of my NSF REU project, which is co-mentored by Dr. Yi Wu in the Department of Sociology, Anthropology, and Criminal Justice and Dr. Kirby Player in the College of Agriculture, Forestry, and Life Sciences.

Rohan Goli

Keyphrase Identification with Limited Labeled Dataset using Deep Active Learning & Domain Adaptation

Interoperability is a well-recognized barrier in the health field. To facilitate the interoperability of clinical decision support systems (CDSS) rules, we propose using Semantic Web technologies to build an ontology for CDSS. To iteratively improve the prediction of unseen corpora and produce results comparable to a human domain expert (HDE) annotator, we are building a keyphrase (KP) identification model by using available CDSS text resources with human feedback. This model will provide candidate phrases for HDE to review before adding to the CDSS ontology.

One of the key challenges to building the pipeline is the imbalance between labeled and unlabeled data (98% is unlabeled). Here, creating ground truth labels is expensive as it requires HDE to identify the KP manually. To overcome this problem, we generate synthetic KP labels using a pre-trained biomedical transformer model and use them as labels to initially train our bi-directional long short-term memory model.

With synthetic labels in place, we experiment on training the model to select the best subset of input representations (statistical/linguistic/contextual text features) contributing towards performance through domain adaptation and active learning (AL). The least confident prediction results during the test are reviewed by HDE using AL-based test sample selection methods to learn independent and diverse recognition patterns.

This HDE continued feedback lets the model learn the KP identification with minimal labeling. Over the course of time, with annotators' feedback, we hope to improve the prediction gradually to satisfactory metrics. This work contributes to the manual review process while constructing and maintaining the CDSS ontology, and the methodology contributes to the field of Natural Language Processing (NLP) dealing with AL and imbalanced datasets.

Salman Naveed

Alterations in Cotton Growth Habit to Remobilize End-of-Season Perennial Reserves for Increased Yield

Cotton (Gossypium spp.) is the primary source of natural fiber in the U.S. and a major crop in the Southeastern U.S. Despite constant efforts to increase the cotton fiber yield, the yield gain has stagnated. Therefore, we undertook a novel approach to improve the cotton fiber yield by altering its growth habit from perennial to annual. In this effort, we identified genotypes with high-expression alleles of five floral induction and meristem identity genes (FT, SOC1, FUL, LFY, and AP1) from an upland cotton mini-core collection and crossed them in various combinations to develop cotton lines with annual growth habit, optimal flowering time and enhanced productivity. To facilitate the characterization of genotypes with the desired combinations of stacked alleles, we

identified markers associated with the gene expression traits via genome-wide association analysis using a 63K SNP Array (Hulse-Kemp et al. 2015 G3 5:1187). Over 14,500 SNPs showed polymorphism and were used for association analysis. A total of 396 markers showed association with expression traits. Out of these 396 markers, 159 mapped to genes, 50 to untranslated regions, and 187 to random genomic regions. Biased genomic distribution of associated markers was observed where more trait-associated markers mapped to the cotton D sub-genome. Many quantitative trait loci coincided at specific genomic regions. This observation has implications as these traits could be bred together. The analysis also allowed the identification of candidate regulators of the expression patterns of these floral induction and meristem identity genes whose functions will be validated via virus-induced gene silencing.

Samantha Scott

Sentence Writing for Students with Disabilities: Results of a Pilot Study

The poster presentation will discuss the results from a pilot study conducted in the fall of 2021. The study aimed to evaluate a series of sentence writing intervention lessons developed for students with learning disabilities as part of a federal grant project. The content area of writing was selected for the project as it is an understudied area in special education research. Teachers grapple with how to meet the needs of young struggling writers. Generally, they feel less prepared to teach writing than other content areas due to inadequate preparation and lack of available writing assessments and interventions. In addition, current research shows that most students struggle with writing and that students with learning disabilities struggle at a higher rate. For the pilot study, Dr. Abigail Allen and I worked with three elementary level students with learning disabilities three days a week for four weeks to deliver lessons and collect student work samples and teacher feedback. We will share our pilot study data results and how the information collected will shape our future research methods and lesson development over the next three years of the project.

William T. Pennington

Deep Eutectic Solvents based on Halogen Bonding

Deep Eutectic Solvents (DESs) are a high impact field of study given their promise as novel solvents for electrochemical systems, materials/environmental processing, catalysis, biosensors, separations, and other chemical reactions. The vast majority of DESs are constructed of constituent molecules or ions that interact with one another through hydrogen bonding. Since the nature of the interactions between molecules influences the properties of the resulting DESs, there is great interest in identifying new chemical systems that form DESs. DESs that involve different intermolecular interactions may be particularly interesting since they may possess significantly different solvation properties based on their differing interactions. Halogen bonding has recently been developed as a complementary tool to hydrogen bonding in crystal engineering, where intermolecular interactions are studied to rationally design new materials with specific properties. We will utilize halogen bonding interactions to similarly design new DESs. Based on our initial example of halogen bonding DESs, we have identified several high potential phase space systems to explore. Using an empirical, combinatorial approach via

mechanochemistry new DESs will be identified and then characterized by spectral and thermal analysis. Systems that do not form DESs via mechanochemistry will be subject to crystallization and single crystal X-ray diffraction, providing additional understanding of the intermolecular interactions surrounding these systems, and supporting the design of subsequent reactions. In this study, both DES and crystal formation prove to be valuable results. We will partner with AI specialists to develop a database of DES-forming compositions, creating a complementary empirical-computational feedback loop intended to add a predictive element to the design of new DESs.

Zehua Jin

Single Atom PGMs Boost Hydrocarbon Formations over Copper Catalyst in Electrocatalytic CO2 Reduction

Although Cu is the best-known catalytic component to catalyze the hydrocarbons (HCs) formation in CO2 reduction reaction (CO2RR), the Cu-based hydrogenation catalysis is often limited by the sluggish kinetics. Herein, we alloyed a trace amount of platinum group metals on Cu particles as Pd1Cu and Pt1Cu single-atom alloy (SAA) catalysts, which managed to show over ten times higher HCs (CH4 and C2H4) formation rates in CO2RR with a current density up to -220 mA/cm2. The evidence from CO-striping, Tafel slope, and in situ ATR-SEIRAS studies suggests the hydrogen-assisted CO2RR mechanism. Extending the studies to Cu-shape-controlled catalysts confirm that the Cu facets governed the major product distribution towards either CH4 (60%) or C2H4 (55%), meaning the selectivity is governed by Cu nature while SAA enhances hydrogenation. This is the first proof that the SAA strategy, even when PGMs were utilized as seemingly wrong components, can be adopted to CO2RR to improve the efficiency of HCs production.