

Presentation Number: 300

Presentation Title: Inhibiting Migration of Endothelial-Derived Mesenchymal Cells Using a Nanoparticle-Based Photothermal Treatment Impedes Atherosclerosis and Cancer Progression

Student Name: Xin Luo
xin.luo@mines.sdsmt.edu
Biomedical Engineering

Advisor: Dr. Congzhou Wang
Nanoscience and Biomedical Engineering

Abstract: The migration and invasion of endothelial-derived mesenchymal cells (EMCs) play a crucial role in both atherosclerotic plaque formation and cancer metastasis. However, current strategies aimed at suppressing EMC formation often suffer from poor specificity and undesirable side effects, and few efforts have directly targeted the migratory and invasive behavior of EMCs. In this study, we present a nanoparticle-based strategy to specifically inhibit EMC migration and invasion using cadherin-2 targeted melanin nanoparticles in combination with mild photothermal treatment. Cell migration and invasion assays demonstrate that the synergistic effect of nanoparticle uptake and photothermal treatment effectively impedes EMC motility. Atomic force and super resolution microscopy indicate that this inhibition is associated with disruption of the actin cytoskeleton and consequent morphological alterations. Furthermore, Western blot analyses elucidate the underlying molecular mechanism, showing that cadherin-2 dependent RhoA activation is downregulated by the combined nanoparticle and photothermal treatment, leading to cytoskeletal disorganization. Overall, these in vitro findings serve as a proof-of-concept study for a potential alternative or complementary strategy to attenuate atherosclerotic plaque development and cancer metastasis by targeting the migration and invasion of EMCs from a novel mechanistic perspective.

Poster Presentation
Graduate Student

Presentation Number: 301

Presentation Title: Comparative Analysis of Enzyme Interactions in the Flavonoid Biosynthetic Pathway of Blonde and Blood Oranges

Student Name: Jide Popoola

jide.popoola@mines.sdsmt.edu

Chemical and Biological Sciences

Advisor: Dr. Daniel Owens

Chemical and Biological Sciences

Abstract: Flavonoids are the major secondary metabolites in citrus fruits and play fundamental roles in pigmentation, antioxidant activity, and stress responses. Differences between Blonde and Blood oranges depend mainly on differences in the flavonoid biosynthesis pathway and the network of interactions among key enzymes that channel substrates toward colored or non-colored end products. This work focuses on structural and functional differences in the flavonoid biosynthetic pathway of Blonde and Blood oranges, highlighting enzyme–enzyme interactions that are important regulators of metabolic flux. RNA isolation and cDNA synthesis were carried out from the leaf tissues of both Blonde and Blood orange, followed by PCR amplification for major biosynthetic genes, namely CHS, CHI, F3H, FLS, DFR, and ANS. Protein–protein interaction analysis by Y2H assays has been used to assess whether enzymes form metabolons or substrate-channeling complexes impacting flavonoid accumulation patterns. Preliminary results from amplification indicate successful expression of key pathway genes in both varieties, though interaction screening points toward differences in the pairing of downstream enzymes such as DFR and ANS enzymes strongly associated with anthocyanin formation in Blood oranges. Our findings point out that in Blonde and Blood oranges, the variation in the flavonoid profiles may not rely on gene presence alone but rather on dynamic interactions among enzymes that regulate substrate flow toward flavonols or anthocyanins. Understanding these interactions gives insight into the metabolic regulation in citrus and supports future work on improving fruit nutritional quality, pigmentation, and stress tolerance through metabolic engineering.

Poster Presentation

Graduate Student

Presentation Number: 302

Presentation Title: PAN/UiO-66-Amidoxime Composite Sponge for Gallium Recovery

Student Name: Weikang Ke

weikang.ke@mines.sdsmt.edu

Department of Chemistry, Biology & Health Sciences

Advisor: Dr. Fan Zheng

Department of Chemistry, Biology & Health Sciences

Abstract: An ultraporous composite membrane was developed by integrating electrospun polyacrylonitrile (PAN) nanofibrous mats with UiO-66-AO, an amidoxime functionalized metal-organic framework (MOF), for high-efficiency gallium recovery.

The electrospun PAN nanofibers provide a macroporous and mechanically robust support, while UiO-66-AO enhances performance through (1) amidoxime groups that selectively bind gallium ions and (2) a high surface area from microporous architecture that improves adsorption capacity and kinetics. A three-dimensional spongy membrane was achieved via freeze-drying after crosslinking of polyvinyl alcohol (PVA) with PAN nanofibrous fragments. Structural and compositional characterization was performed using Fourier Transform Infrared Spectroscopy (FTIR), optical microscopy, scanning electron microscopy (SEM), and X-ray diffraction (XRD). Future work will assess mechanical properties, gallium adsorption efficiency (capacity, selectivity, and kinetics), membrane stability under operational conditions, and regeneration performance over multiple adsorption-desorption cycles.

Poster Presentation

Graduate Student

Presentation Number: 303

Presentation Title: Biomanufacturing Ultra-High Molecular Weight Protein Biomaterial in yeast via Split-intein polymerization

Student Name: Swati Srivastava

swati.srivastava@mines.sdsmt.edu

Civil and Environmental Engineering

Advisor: Dr. Saurabh Sudha Dhiman

CBHS/CEE

Abstract: Biomanufacturing of ultra-high molecular weight (UHMW) protein-derived biomaterial remains a defining bottleneck in bio-inspired materials engineering, as conventional prokaryotic systems lack the post-translational modification (PTM) machinery required. While lower eukaryotic systems possess the PTM components, it often fails to assemble monomeric protein chains of various lengths. To overcome these existing challenges in biomanufacturing, we developed a transformative cell expression strategy by deploying split-intein-mediated polymerization into an engineered yeast, i.e., *Pichia* sp. Leveraging *Pichia* sp. inherent PTM machinery and extracellular secretion pathways, we designed a pioneering plasmid construct encoding the UHMW monomeric subunit flanked by de novo designed split-intein pairs. The plasmid construct was computationally validated for its stability and subsequently transformed into the *Pichia* sp. Electrophoresis and Mass Spectrometry approaches have confirmed the expression of the monomeric UHMW protein. Follow-up harvesting of the heterologously expressed UHMW protein has validated ~6-fold increase in its molecular weight, validating at least 6-fold polymerization of the monomeric subunit. The designed research establishes a sustainable Living-Cell Factory leveraging the broad substrate specificity, inherent PTM machinery, and extracellular secretory features of a lower eukaryotic host. The modularity of the designed split-intein framework enables authoritative and tailored polymerization of UHMW biomaterials, positioning it as a highly versatile production paradigm, with direct implications in tissue engineering and self-healing structural bio-composites.

Poster Presentation

Graduate Student

Presentation Number: 304

Presentation Title: PILLAR RECOVERY SCHEDULING WITH BACKFILL CONSTRAINTS FOR VALUE MAXIMIZATION

Student Name: Jose Mujica

jose.mujicacabrera@mines.sdsmt.edu

Mining Engineering & Management

Advisor: Dr. Andrea Brickey

Mining Engineering & Management Department

Abstract: Underground pillars are commonly left in place due to safety, sequencing, or economic constraints. However, changes in market conditions and backfill practices may create opportunities for their recovery. Traditional production schedules often exclude pillar extraction and do not explicitly account for backfill timing constraints, potentially underestimating the overall economic value of the deposit.

This study evaluates the integration of pillar recovery into underground mine scheduling using an optimization framework that incorporates tonnage, grade/NSR, backfill volume requirements, precedence relationships, and operational constraints. An OPP solver is used to generate production schedules that maximize discounted cash flow while maintaining feasibility under backfill limitations.

The expected outcome is an optimized extraction sequence that identifies economically viable pillars and improves net present value (NPV) compared to conventional scheduling approaches. By explicitly modeling backfill constraints, this research provides a more realistic and value-focused framework for underground production planning.

Poster Presentation

Graduate Student

Presentation Number: 305

Presentation Title: Open-pit production scheduling with autonomous haulage systems: Short to medium-term planning

Student Name: Katekani Maswanganyi

katekani.maswanganyi@mines.sdsmt.edu

Mining Engineering and Management

Advisor: Dr. Andrea Brickey

Mining Engineering and Management

Abstract: In an effort to improve occupational safety and efficiency in the mining industry, mining operations are adopting autonomous haulage systems (AHS). This research develops an optimization framework that incorporates long-term production planning with detailed short-term scheduling for AHS in open-pit mines. While long-term planning establishes production targets and fleet capacity, short-term scheduling determines daily truck-shovel assignments under operational constraints. The proposed model incorporates multiple time horizons and time fidelity to evaluate the alignment between shift level scheduling decisions and long-term production objectives. A case study of an open-pit gold mine will be used to test and validate the model. The research aims to assess the impact of integrated multi-horizon scheduling on equipment utilization, production throughput, and project net present value (NPV), thereby contributing to improved decision making in open-pit AHS.

Poster Presentation

Graduate Student

Presentation Number: 306

Presentation Title: Data-Driven Modeling for Power Demand Behavior at Residential Level

Student Name: Somaieh Kharazi

somaieh.kharazi@mines.sdsmt.edu

Electrical Engineering and Computer Science

Advisor: Long Zhao

Electrical Engineering and Computer Science

Abstract: In the U.S., residential consumers account for approximately 40% of total electricity consumption, making the residential sector the largest electricity-consuming sector compared to industrial and commercial sectors. This substantial share highlights the critical role households play in shaping overall load patterns.

One of the most significant drivers of residential electricity demand is temperature. Electricity consumption in homes is highly sensitive to temperature variations, primarily due to heating, ventilation, and air-conditioning (HVAC) systems. It is estimated that nearly one-third of residential electricity consumption is attributable to temperature-dependent equipment. As climate variability intensifies and extreme weather events become more frequent, this temperature sensitivity is expected to become even more pronounced.

In this context, our research focuses on developing a data-driven model to characterize household-level electricity demand using advanced data mining and machine learning techniques. The central objective is to model residential power demand as a function of time and temperature—two of the most influential determinants of electricity usage. To accurately capture these dynamics, we are developing a Temperature-Time-Day (TTD) model that quantifies and integrates the combined effects of temporal and meteorological variables on residential electricity demand. As part of this framework, we first constructed a model to quantify the impact of temperature on household consumption.

Building upon these findings, we apply clustering techniques to group residential consumers based on their temperature responsiveness and usage patterns. The goal of clustering is to identify segments of consumers with similar characteristics—for example, households that exhibit strong winter heating loads or those highly sensitive to summer cooling demand. By distinguishing these behavioral patterns, the model enables more targeted and insightful analysis.

Poster Presentation

Graduate Student

Presentation Number: 307

Presentation Title: Sustainable Management and Treatment of Mine Wastewater: A Review of Water Sources and Applications

Student Name: Lilyrose Berko-Ampofo

lilyrose.berko-ampofo@mines.sdsmt.edu

Mining Engineering and Management

Advisor: Dr. Andrea Brickey

Mining Engineering and Management

Abstract: Water is a necessary resource for humans, ecosystems, and industrial operations, e.g., mining. In the mining sector, water plays a pivotal role and influences every phase of a mine's operation, from exploration to reclamation, requiring a focus on water quality and environmental sustainability. With the growing need for water globally, focus has been placed on adopting more sustainable mining practices that emphasize effective water management, treatment, and reuse of mine wastewater. This research evaluates conventional and advanced treatment technologies, demonstrating that the selection of an effective treatment method is based on understanding mine water sources, flows, chemistry, and usage. This paper also reviews global case studies of mines that faced severe water-related challenges and discusses lessons learned. Based on this review, a framework is developed that provides guidance to engineers regarding best practices for unique situations related to mine site hydrology. Furthermore, this framework will provide an early-stage evaluation to minimize future financial and environmental risks.

Poster Presentation

Graduate Student

Presentation Number: 308

Presentation Title: It's a Dog Eats Dog World: Characterizing Scavenger Behaviors in the Great Plains

Student Name: Claire Wolfe

claire.wolfe@mines.sdsmt.edu

Geology & Geological Engineering

Advisor: Sarah Keenan

Geology & Geological Engineering

Abstract: The recognition of scavenger behavior in the fossil record is a difficult task. Teeth marks and fossil aggregations are often the only ways to recognize the presence of scavengers. This evidence does not distinguish between an animal acting as a scavenger or a predator and does not account for the behaviors modern scavengers exhibit that cannot be preserved in the fossil record. The seasonal nuances in scavenger behavior are even harder to account for. While scavengers have been described in other regions, the Great Plains region's scavengers remain undescribed. With the variety of species in the Great Plains that are present today and in the fossil record, and with the plains environment remaining similar to what it was in the past, the descriptions of modern plains behaviors can serve as an analog for scavenging behaviors that are not captured by the fossil record. Using coyote carcasses and game cameras, over a winter and a late summer/early fall trial, the visitors and their interactions with each carcass were recorded. While both trials experienced significantly different accumulated degree days, the number of daily total visitors was not significantly different between each trial. With these visitors, no scavenging occurred within the winter trial, while the summer/fall trial saw minor acts of scavenging (picking of fur, burrowing into the chest, full carcass movement). The scavenging did not impact the rate of decomposition when compared to the controls kept in a scavenger-proof enclosure. With the low-impact nature of the observed interactions, they are not likely to be preserved in the fossil record. While each trial saw many of the same carcass visitors, there were species only observed during the summer/fall trial. With the observations collected from the trials, it is thought that there are temperature-based nuances to plains species behaviors, with different species present at different temperatures, and no scavenging occurring in cooler temperatures.

Poster Presentation

Graduate Student

Presentation Number: 309

Presentation Title: A Microfluidics Device for Labelling and Washing Cells

Student Name: Samuel Clark Van Osdel

samuel.vanosdel@mines.sdsmt.edu

Biomedical Engineering

Advisor: Dr. Brandon Scott

Biomedical Engineering

Abstract: Microfluidic devices use microscale channel geometries to manipulate fluids and suspended particles. Our lab is developing a spiral microfluidic device for on-chip cell sorting designed to autonomously label and wash cells, reducing preparation time from hours to minutes and increasing throughput.

Spiral microchannels generate three primary forces on suspended cells: Dean drag, shear lift, and wall lift. The balance of these forces drives cells from an initially random distribution into focused bands at specific cross-sectional positions. Band location and width depend on channel dimensions, flow rate, and cell diameter. Adjusting these parameters alters the force balance, enabling size-based separation as differently sized particles focus at distinct positions.

This size-dependent focusing phenomenon is well documented and forms the foundation of our approach. Because microfluidic systems operate in the laminar flow regime, streamlines do not mix. By combining inertial focusing with laminar flow, our objective is to transfer cells between streamlines within the device to enable washing and labeling on-chip.

This presentation will outline the design methodology of our current device iteration, including the geometric rationale supported by literature, and describe our development pipeline: modeling, simulation, and experimental validation. I will also discuss the custom fluid control system we developed, along with current progress and future directions.

Poster Presentation

Graduate Student

Presentation Number: 310

Presentation Title: Temporal Dynamics of PI3P During Macropinosome Formation in Fetal Liver Macrophages

Student Name: Peng Yin
peng.yin@mines.sdsmt.edu
NANO & BME

Advisor: Brandon Scott (PhD)
NANO & BME

Abstract: Macropinocytosis is a crucial endocytic process by which macrophages internalize large volumes of extracellular fluid. Phosphatidylinositol 3-phosphate (PI3P) is known to regulate macropinosome fusion with early endocytic organelles and accumulate on mature macropinosome. However, the precise temporal recruitment of PI3P during the early stages of macropinosome formation, specifically during cup formation, remains unclear. Using oblique plane microscopy (OPM) to achieve high spatiotemporal resolution, we investigated whether PI3P, visualized with the 2xFYVE-mScarlet fluorescent probe, is present during cup formation before macropinosome closure in fetal liver macrophages. Fetal liver macrophages represent an important developmental macrophage population that performs constitutive macropinocytosis. Our preliminary time-lapse imaging of the initial cohort of cells revealed that mScarlet signal was absent during the membrane ruffling and cup formation stages in the macropinocytosis events observed thus far. These initial findings suggest the possibility that PI3P recruitment may occur post-closure as part of macropinosome maturation rather than during the initial cup formation phase. However, these results represent early observations from a limited sample set. To establish statistical significance and confirm this temporal pattern, we are continuing to image additional fetal liver macrophages to expand our dataset. Further analysis of a larger cell population will be necessary to definitively determine whether PI3P is consistently absent during cup formation or whether temporal variations exist across different macropinocytosis events and individual cells. This ongoing work aims to provide comprehensive insights into the spatiotemporal coordination of lipid signaling during macropinocytosis in developmentally relevant macrophage populations.

Poster Presentation
Graduate Student

Presentation Number: 311

Presentation Title: Exploration of Magnesium Diboride Pyrotechnic Formulations for the Decomposition of Chemical Warfare Agents

Student Name: Brandilyn Ukena
brandilyn.ukena@mines.sdsmt.edu
CBE

Advisor: Dr. Lori Groven
CBE

Abstract: The decomposition of chemical warfare agents (CWAs) remains a critical challenge. Diisopropyl methyl phosphate (DIMP) is widely used as a non-toxic surrogate to model the behavior and degradation pathways of organophosphonate nerve agents. Magnesium oxide (MgO) has demonstrated strong efficacy in decomposing both vapor and liquid phase DIMP and exhibits high adsorption for a variety of CWA stimulants. However, conventional MgO synthesis routes are often energy intensive, time consuming or limited in scalability. This study explores an alternative production pathway for reactive MgO via the combustion of magnesium diboride pyrotechnic formulations. Oxidizer systems were systematically varied to evaluate their effects on combustion behavior, oxide yield, and product characteristics. Formulations were optimized to promote complete combustion and the formation of high-surface-area, nanoscale MgO. The resulting materials were characterized to assess phase composition and catalytic performance toward DIMP degradation.

Poster Presentation
Graduate Student

Presentation Number: 312

Presentation Title: Thermophilic Nitrogen-Fixing Cyanobacteria from Yellowstone National Park as a Platform for Sustainable Biohydrogen Production

Student Name: Ishika Garg

ishika.garg@mines.sdsmt.edu

Chemical and Biological Engineering

Advisor: Dr. Rajesh Sani

Chemical and Biological Engineering

Abstract: Modern agriculture depends on nitrogen, yet producing over 180 million metric tons of synthetic fertilizer each year is energy-intensive and a significant source of greenhouse gas emissions. Biological nitrogen fixation offers a sustainable alternative that generates hydrogen as a natural byproduct, but thermophilic systems and thermostable cyanobacterial nitrogenases remain largely unexplored. This study focuses on isolating thermophilic nitrogen-fixing cyanobacteria from geothermal environments in Yellowstone National Park. We hypothesize that cyanobacteria adapted to elevated temperatures (60-73°C) exhibit enhanced nitrogenase stability and sustained metabolic activity, enabling efficient nitrogen fixation coupled with hydrogen evolution under thermophilic conditions. Enrichment and isolation were conducted at 60°C, 65°C, and 73°C to target high-temperature adapted strains. Sustained growth was established at elevated temperatures, and isolates were verified for purity using light microscopy. Media composition was refined using geochemical modeling with MINTeq to better simulate thermal spring chemistry and support thermophilic growth. Inductively Coupled Plasma Mass Spectrometry (ICPMS) characterized trace metals relevant to nitrogenase cofactors. In parallel, metagenomic sequencing of Yellowstone samples was performed to assess microbial community composition and identify potential nitrogen-fixing cyanobacteria; these data are currently under analysis. These findings establish progress toward thermophilic biological nitrogen fixation linked to biohydrogen production. Future work will include nif gene analysis, functional validation of nitrogen fixation and hydrogen evolution, optimization of nitrogenase activity, and characterization of thermostable systems. We are also developing CyanoVault, a curated repository to catalog and preserve thermophilic cyanobacterial isolates for the extremophile research community.

Poster Presentation

Graduate Student

Presentation Number: 313

Presentation Title: Expanding the Culture Inventory of Thermophilic Diazotrophic Cyanobacteria from Yellowstone Geothermal Springs

Student Name: Rimjhim Sharma
rimjhim.sharma@mines.sdsmt.edu
Chemical and Biological Engineering

Advisor: Dr. Tanvi Govil
Chemical and Biological Engineering Department

Abstract: Biological nitrogen fixation sustains global nutrient cycling, yet its operation under sustained thermal stress remains poorly understood. Nitrogenase is an oxygen-sensitive, energy-intensive enzyme that converts atmospheric nitrogen into biologically usable forms. While mesophilic diazotrophs are well studied, thermophilic nitrogen-fixing cyanobacteria are rarely cultured, limiting insight into nitrogen fixation at high temperatures. Understanding this metabolism at elevated temperatures is increasingly important as engineered biological systems move toward more robust, high-temperature operation to improve stability, kinetics, and contamination resistance. To address this limitation, we investigated cyanobacterial communities from four geochemically distinct geothermal springs in Yellowstone National Park: Mushroom Pool, Five Sisters, White Creek, and Octopus Spring. Site characterization using ion chromatography, inductively coupled plasma mass spectrometry, and total organic/inorganic carbon analysis defined physicochemical conditions associated with thermophilic phototrophic growth. Guided by these profiles, selective nitrogen-depleted enrichments were established at 45°C and 55°C to suppress mesophilic competitors and promote thermophilic diazotrophs. This approach recovered stable thermophilic phototrophic consortia and filamentous, heterocyst-forming isolates consistent with aerobic nitrogen fixation. Distinct morphotypes from different springs indicate site-specific adaptation and underexplored thermophilic diversity. Ongoing 16S rRNA gene sequencing and physiological characterization will link isolate identity to geochemical origin and evaluate nitrogen-fixing capability. By converting geothermal microbial diversity into laboratory-stable strains, this work establishes a reproducible framework for studying nitrogen fixation under thermal stress and expands the resource base for high-temperature biological systems research.

Poster Presentation
Graduate Student

Presentation Number: 314

Presentation Title: Sub-Layer Engineering of Multifunctional Composites for Superior Impact and Ballistic Performance

Student Name: Palash Kumar Saha

palash.saha@mines.sdsmt.edu

Nanoscience and Biomedical Engineering Department

Advisor: Dr David R Salem

Nanoscience and Biomedical Engineering Department

Abstract: The provision of lightweight building materials with significant thermal insulation performance, structural load bearing properties, and protective shielding of occupants from high energy impacts is a prerequisite to sustain critical defense facilities in remote, cold regions. Composite materials, particularly multi-layered composites combined with syntactic foam, offer a promising solution to address these multifunctional needs. Based on an impact/blast tuning concept, Adewole, a former researcher in our group, developed a multilayer composite, later refined by Olowonigba in our group, that efficiently absorbs 1000 J energy impacts (using a 2-inch hemispherical projectile) and provides good thermal insulation properties. While this impact performance is impressive for a low density ($< 1\text{g/cm}^3$) material, there is strong interest in increasing the impact resistance of these multilayer composites (Structural Thermal Insulation and Impact Resistant Composite (STIIRC) panels) still further, since at impact energies higher than 1000 J, they have been shown to be susceptible to delamination at a critical interface. To mitigate this limitation, the present study introduces sublayer engineering, especially involving the incorporation and systematic reconfiguration of ballistic fabrics in the structural panels. The effects of these different layup configurations on the impact response of the panels at different impact energy levels was investigated. The impact results show a promising reduction in delamination and back-face deflection when the layer sequence is optimized, substantially enhancing the impact and ballistic resistance of the panels. This study reports on the fabrication of these structurally engineered composites and demonstrates the elimination of delamination and other failure at impact energies up to at least 1400 J using a 2-inch diameter hemispherical impactor head and up to 1300 J using a $\frac{1}{2}$ inch diameter hemispherical impactor head.

Poster Presentation

Graduate Student

Presentation Number: 315

Presentation Title: A Comparative Analysis of ECOSTRESS Daily Evapotranspiration Estimates and AmeriFlux Eddy Covariance Tower Measurements

Student Name: Samantha Peppel
samantha.peppel@mines.sdsmt.edu
Civil and Environmental Engineering

Advisor: Dr. Edson Costa Filho
Civil and Environmental Engineering

Abstract: Evapotranspiration (ET) is a key component in water resource management which helps quantify land-atmosphere energy and water interactions. Remote sensing-based ET products provide spatially continuous coverage but need validation to assess their accuracy at the site scale. This study aims to analyze the accuracy of NASA's ECOSTRESS (ECOSystem Spaceborne Thermal Radiometer Experiment on Space Station) daily satellite ET predictions against AmeriFlux ET measurements in forested ecosystems from 2019-2024. Data analysis included four AmeriFlux sites with different vegetation types and environmental constraints. Data availability varied due to the daytime available data. The application of a 2D footprint model provided spatially averaged values of ECOSTRESS ET to compare to the AmeriFlux daily ET from energy flux towers that use the Eddy Covariance (EC) approach to indirectly measure ET. Turbulent heat flux data measurements did not have any adjustment for energy balance closure. Preliminary results indicate that ECOSTRESS daily ET products ranged by -0.30 ± 1.09 mm d⁻¹ (MBE \pm RMSE), a clear underestimation of ET by approximately 22% when assessing the combined data from all sites. Site US_xRM provided the lowest normalized RMSE (± 18 %), whereas site US_xWR provided the highest RMSE (± 110 %). Overall, this satellite-based ET prediction showed an acceptable agreement with the flux tower-measured ET over forested ecosystems.

Poster Presentation
Graduate Student

Presentation Number: 316

Presentation Title: Generation and Characterization of a Radially Polarized Beam

Student Name: Eniola Rotinwa

abdulbasit.rotinwa@mines.sdsmt.edu

Nanoscience and Nanoengineering

Advisor: Dr Steve Smith

Nanoscience and Nanoengineering

Abstract: Radially polarized vector beams generate a strong longitudinal electric-field component under tight focusing, which can enhance surface-sensitive nonlinear signals such as second-harmonic generation (SHG). This makes them promising for tip-enhanced SHG and femtosecond scanning-probe microscopy. We generate and characterize a radially polarized femtosecond beam from a Ti:Sapphire laser operating near 810 nm. Following established liquid-crystal q-plate approaches for vector-beam generation, a linearly polarized Gaussian beam is converted to circular polarization and then passed through a q-plate adjusted to operate near half-wave retardance at the laser wavelength. The resulting output is expected to display an annular (donut-like) intensity distribution consistent with a first-order cylindrical vector mode. To verify the radial polarization state, an analyzer-angle-resolved beam imaging system using a rotating linear polarizer results in a two-lobe pattern. From this rotating-polarizer image series, we quantify (i) the polarizer-angle-dependent transmitted power modulation and (ii) the dark-bar visibility between the lobes as the analyzer rotates, and compare these metrics to the ideal versus imperfect radial polarization in Ma and Wu's model. The resulting radially polarized excitation will serve as a validated input for subsequent femtosecond scanning probe experiments, where ultrafast excitation is localized by a nanoscale probe to access sub-diffraction spatial information. Such an approach is broadly relevant for mapping nanoscale optical nonlinearities and local symmetry breaking in 2D materials, hotspot-driven responses in metamaterials, and label-free contrast mechanisms in bioimaging.

Poster Presentation

Graduate Student

Presentation Number: 317

Presentation Title: Spectrally-resolved Polarization-resolved Multiphoton Luminescence and Second Harmonic Imaging in Low-dimensional Materials

Student Name: Arik Ahmed

arik.ahmed@mines.sdsmt.edu

Nanoscience and Biomedical Engineering

Advisor: Steve Smith

Nanoscience and Biomedical Engineering

Abstract: Quantum entanglement is a phenomenon where multiple particles possess features (e.g. position, momentum, polarization, etc.) that remain correlated even across large distances. Entangled photon pairs can be used in applications such as quantum cryptography and quantum computing. Second-order nonlinear susceptibility is an important materials property for the generation of entangled photon pairs, which can be notably enhanced in low-dimensional materials. A spectrally-resolved multi-photon induced luminescence (MPL) and second harmonic generation (SHG) imaging system, based on a closed loop piezoelectric stage, a transmission grating and an EMCCD is used to examine the nonlinear optical properties of low-dimensional materials. We visualize the spectrally-resolved MPL (luminescence) and SHG in the two-dimensional (2D) material WSe₂ along with angularly resolved SHG spectroscopy. We also perform similar measurements for In₂Se₃, CuCrP₂S₆, and heterostructures of WSe₂/hBN.

Poster Presentation

Graduate Student

Presentation Number: 318

Presentation Title: BTNN: Bayesian Temporal Neural Network

Student Name: Jacob James

Jacob.James@mines.sdsmt.edu

Computer Science

Advisor: Dr. Randy Hoover

Computer Science

Abstract: Many real-world time series problems encounter change in the incoming data, whether that be degrading sensors or changes in the data being collected. The work in this poster attempts to solve the case where this change in incoming data happens at a constant and continuous rate. Simulated data was created in the form of binary classification in order to test the capabilities of the Bayesian Temporal Neural Network (BTNN). The BTNN enforces a Gaussian Process on a set of neural network parameters over time, allowing for smooth updates. To reduce memory and time complexity, two techniques were enforced and tested: A transportation matrix to transport a smaller network to the original larger network architecture, Linear Interpolation across time of the model parameters. Each method was tested with respect to accuracy and computation time, providing a solid foundation to expand to more complicated model architectures and data sets.

Poster Presentation

Graduate Student

Presentation Number: 319

Presentation Title: Emerging Trends in Optical Borehole Imaging: 3D Visualization, AI Integration, and Future Directions

Student Name: Millicent Oppong
millicent.oppong@mines.sdsmt.edu
Mining Engineering

Advisor: Rudrajit Mitra
Mining Engineering and Management

Abstract: Borehole imaging helps visualize underground conditions and geological features that affect the strength and safety of underground excavations. Recent technological advancements have significantly improved camera resolution, borehole coverage, and data interpretability. This study discusses the ability of modern optical imaging systems to generate detailed three-dimensional representations of borehole walls and how the integration of artificial intelligence for feature extraction has enhanced conventional optical borehole imaging devices. Emphasis is placed on new developments such as improvements in key components of the imaging tool, automatic feature detection, and multi-source data integration which collectively enhances predictive capabilities and decision making. Challenges such as identifying geologic rock types that play an important role in fracture development are examined alongside future research directions.

Poster Presentation
Graduate Student

Presentation Number: 320

Presentation Title: Novel Actinomycetes from Pine Ridge: Functional Insights for Sustainable Agriculture and Biotechnology

Student Name: Samiksha Sapkota
samiksha.sapkota@mines.sdsmt.edu
CBHS

Advisor: Dr. Ram Nageena Singh[1], Dr. Rajesh K. Sani [1,2]
1. CBE, 2. CBHS

Abstract: Soil is a rich source of microbial diversity, hosting a diverse group of bacteria, fungi, and actinomycetes that play critical roles in nutrient cycling and ecosystem functioning. Actinomycetes are a very important microbial group in the soil and contribute to soil nutrition, helping plants to combat pathogens. They are filamentous Gram-positive bacteria known for producing bioactive secondary metabolites and extracellular enzymes with applications in agriculture, industry, and medicine. To date, no published studies have specifically reported the isolation and characterization of actinomycetes from soils of the Pine Ridge Reservation, highlighting the untapped potential of this region as a source of novel microbial diversity and bioactive metabolites. This study aims to isolate, identify, and characterize bacteria and actinomycetes from Hemp rhizosphere soil samples to explore their potential for agricultural and biotechnological use. Soil dilution and spread plate techniques were applied to isolate the microbes. A total of 38 distinct microbial isolates were obtained by culturing on Nutrient Agar and Actinomycetes Agar and purified through re-streaking. Their morphological characteristics exhibited notable variation. Out of 38 isolates, 23 were creamy, 8 yellow, 5 white, 1 blue, and 1 pink, indicating diverse pigmented bacterial communities. These isolates have diverse colony sizes, including 9 large, 14 medium, 11 small, and 6 tiny colonies, indicating significant morphological diversity. Isolates are currently being identified using 16S rRNA gene sequencing and NCBI BLASTn analysis. The study characterizes these bacteria, specifically actinomycetes, for agricultural traits such as enzymatic activity, siderophore biosynthesis, and antibiotic sensitivity. By exploring these functional traits, the research aims to identify strains with high potential for enhancing soil health, agricultural productivity, and biotechnological innovation.

Poster Presentation
Graduate Student

Presentation Number: 321

Presentation Title: Ejector Effect-Induced Flow Dynamic Characterization within Semi-Enclosed Jet Engine Testing Cells

Student Name: Jace Ruud

jace.ruud@mines.sdsmt.edu

Mechanical Engineering

Advisor: Dr. Joseph Thalakkottor

Mechanical Engineering

Abstract: A computational study with analytical validations was conducted to analyze flow relations surrounding the process of the ejector effect. The ejector effect is a phenomenon where a high velocity core mass flow exhausts from a nozzle into an exhaust duct or mixing chamber, entraining surrounding ambient fluid. Four main flow cases are presented to be investigated within the computational study, each of which systematically increases in complexity. The cases all have the same domain, with a colinear nozzle and exhaust duct. To increase complexity, boundary conditions are changed. Starting from a fully freestream condition, then changing the vertical boundaries to no-slip walls and finally changing the wall aft the exhaust duct to form the semi-enclosed testing cell. The intermediate tests are currently ongoing. Through computational analysis and analytical relation of the nozzle plumes, it is observed that the half-value width (vertical location of the plume where the velocity is half of the axial velocity) is an important parameter, as if the exhaust duct is set to be between the half width diameter and twice the half width diameter, the nozzle exhaust will be effectively ventilated from the testing cell.

Poster Presentation

Graduate Student

Presentation Number: 322

Presentation Title: Non-Destructive Thickness Mapping of 2D Nanosheets Using Optical Microscopy

Student Name: Sachidanand Paruthipatta Sreenivasan

sachidanand.sreenivasan@mines.sdsmt.edu

Nano-BME

Advisor: Dr. Steve Smith

Nano-BME

Abstract: Identification of thickness (layer number) in two-dimensional (2D) materials is essential for understanding their thickness-dependent optical and electronic properties. In this work, we demonstrate a rapid and non-destructive method for determining nanosheet (few atomic layers) thickness using conventional optical microscopy. Optical transmittance value of the thin films containing assorted nanostructures of MoS₂ (revealed by SEM studies) was obtained from optical microscope images taken under white light and laser illumination. The relationship between the reflected light intensity from the substrate and the pixel intensities of the flake images are exploited to establish an approximate correspondence between average pixel intensity and the optical transmittance of the material. We establish a quantitative correlation between optical intensity variation and the layer number of mechanically exfoliated WSe₂ nanosheets. The statistical analysis of regional intensity distribution offers a reliable and rapid identification of mono, few and multi layered 2D materials in future.

Key words: 2D materials, TMDs, Optical transmittance.

Poster Presentation

Graduate Student

Presentation Number: 323

Presentation Title: Integrating Two-Dimensional Materials with Optical Metasurfaces for Nanoscale Control of Quantum Light

Student Name: Leif Gislason

leif.gislason@mines.sdsmt.edu

Nano-BME

Advisor: Steve Smith

Nano-BME

Abstract: Scaling quantum photonic technologies requires compact, efficient light sources capable of producing single or correlated photons on demand. While quantum dots and color centers demonstrate strong performance, they often require cryogenic operation and complex fabrication that limits scalability. Two-dimensional materials offer an alternative platform, hosting optically active defect centers capable of stable single-photon emission at room temperature. Hexagonal boron nitride has emerged as a promising host due to its robust defect-based emitters and compatibility with layered heterostructures [1,2].

Metasurfaces are planar arrays of subwavelength resonators that engineer light–matter interactions by tailoring local electromagnetic fields, phase response, and emission directionality [3]. Integrating two-dimensional quantum emitters with resonant metasurface geometries provides a pathway to enhance spontaneous emission rates, improve photon extraction efficiency, and enable compact on-chip quantum light sources [4].

This work investigates hybrid platforms combining layered two-dimensional materials with lithographically defined gold metasurface structures. Finite-difference time-domain simulations model dipole–resonator interactions and optimize asymmetric rectangular geometries for enhanced Purcell factors and directional emission. In parallel, thermal scanning probe lithography using a NanoFrazor system fabricates subwavelength gold asymmetric rectangles on dielectric substrates, enabling rapid prototyping without conventional electron-beam lithography.

These metasurfaces serve as a testbed for studying how engineered resonances modify the local photonic density of states and emission behavior of nearby quantum emitters. By combining electromagnetic modeling with accessible nanofabrication workflows, this project aims to establish scalable design principles for room-temperature quantum light sources integrated within planar nanophotonic systems.

Poster Presentation

Graduate Student

Presentation Number: 324

Presentation Title: Integrating Physics-Based Simulation and Machine Learning for Germanium Detectors in Medical Imaging

Student Name: Mahiuddin Ahmed
mahiuddin.ahmed@mines.sdsmt.edu
Physics

Advisor: Dr. Matthias Plum
Physics

Abstract: High-purity germanium (HPGe) detectors provide superior energy resolution compared to conventional scintillation detectors, offering strong potential for high-precision gamma-ray medical imaging. This project investigates the integration of machine learning techniques with physics-based detector modeling to improve event reconstruction and interaction localization in germanium-based imaging systems.

Synthetic datasets are generated using detailed simulations of gamma-ray interactions and charge transport within the detector volume. Supervised neural network architectures are being developed to perform event reconstruction. Model performance will be evaluated using simulated cancer phantoms representing heterogeneous tumor geometries embedded in tissue-equivalent media.

This ongoing work aims to establish a framework that combines advanced detector physics with synthetic data-driven algorithms to enhance tumor detectability and quantitative imaging accuracy in next-generation gamma-ray imaging systems.

Poster Presentation
Graduate Student

Presentation Number: 325

Presentation Title: Quantitative Comparison of Phagocytosis and Trogocytosis Using Undifferentiated and Differentiated HL60 Targets

Student Name: Oleksandra Rachynska
oleksandra.rachynska@mines.sdsmt.edu
Biomedical Engineering (BME)

Advisor: Brandon Scott
Biomedical Engineering (BME)

Abstract: Phagocytosis is the process by which a cell engulfs an external target into an intracellular phagosome. Macrophages are professional phagocytes that use this pathway to capture and clear targets, but their interactions do not always lead to full engulfment. In some cases, macrophages nibble membrane from a target without internalizing the entire cell, a process known as trogocytosis. Trogocytosis leaves the target only partially removed, allowing continued survival and representing incomplete clearance rather than full elimination.

Our hypothesis is that target-cell behavior, particularly actin-dependent motility, shifts macrophage–target interactions toward trogocytosis instead of complete engulfment. We used HL60 cells as a target model and examined macrophage interactions with undifferentiated and DMSO-differentiated HL60s across multiple differentiation stages. Target cells were labeled using a biotin/antibiotin strategy to enable standardized recognition and visualization.

To regulate actin-dependent behavior, we used cytoskeleton-targeting drugs: a three-drug JLY cocktail (Jasplakinolide, Latrunculin B, and Y-27632) or Latrunculin B alone. We performed the assay in a multi-well format by adding labeled targets to plated macrophages and imaging interactions using automated time-lapse microscopy on an ImageXpress system. From the movies, we quantified target motility and classified macrophage–target interactions as complete engulfment versus trogocytosis using event-based criteria.

We also used Lattice Light-Sheet Microscopy (LLSM) to acquire high-resolution 3D time-lapse movies of macrophage–HL60 interactions, capturing both full engulfment and trogocytosis across HL60 differentiation stages. Using this combined workflow, we evaluated HL60 uptake outcomes across differentiation and cytoskeleton drug conditions and tested whether more motile targets are more likely to undergo trogocytosis rather than full engulfment.

Poster Presentation
Graduate Student

Presentation Number: 326

Presentation Title: Ferroelectric Control of Spin Filtering in a Multiferroic CuCrP2S6 Tunnel Junction

Student Name: Khimananda Acharya
khimananda.acharya@mines.sdsmt.edu
Physics

Advisor: Tula R. Paudel
Physics

Abstract: CuCrP2S6 (CCPS), a van der Waals multiferroic material, offers a promising platform for electrically controlled spin-filter tunnel junctions by combining switchable electric polarization and layered magnetism within a single barrier. Here, using density functional theory combined with nonequilibrium Green's-function calculations, we investigate spin-dependent transport in an Au/CCPS/Au junction and demonstrate non-volatile electric control of spin-dependent tunneling via polarization-induced modulation of the tunneling barrier. The antiferroelectric phase of CCPS supports highly efficient spin filtering, yielding nearly 100% spin polarization and a giant tunneling magnetoresistance (TMR) of approximately 3100%. In contrast, in the ferroelectric phase, polarization-driven interfacial charge transfer reduces the spin asymmetry of the barrier, lowering the spin polarization to ~67% and suppressing the TMR to ~48%. Momentum-resolved transmission and complex-band analyses reveal that this reduction originates from competing spin-dependent evanescent states across the two-dimensional Brillouin zone. Calculated current-voltage characteristics exhibit distinct, experimentally accessible signatures of polarization-controlled spin filtering, establishing CCPS as a compelling platform for electrically tunable spintronic devices.

Poster Presentation
Graduate Student

Presentation Number: 327

Presentation Title: The Mechanobiology of Diabetic Fibropathy: Regulation of Fibroblast Force Generation by Matrix Stiffness

Student Name: Amelia Huffer
amelia.huffer@mines.sdsmt.edu
BME/NANO

Advisor: Dr. Brandon Scott
NANO/BME

Abstract: Cellular function and morphology are heavily influenced by the mechanical properties of the extracellular matrix (ECM). Fibroblasts typically adopt an activated myofibroblast phenotype characterized by increased contractility and stress fiber formation on stiffer substrates. This mechanosensitive behavior is often dysregulated in diabetic fibroblasts, contributing to impaired wound healing. We hypothesize that substrate stiffness directly modulates fibroblast contractile forces, and that softening the substrate may restore normal contractility in diabetic cells. To test this, we will quantify traction forces in healthy and diabetic fibroblasts cultured on hyaluronic acid (HA)-coated polydimethylsiloxane (PDMS) surfaces of varying stiffnesses. To enable high-resolution imaging on an oblique plane microscope, the PDMS substrates will be spin-coated to a thickness of approximately 10 μm . Fluorescent beads embedded within the substrate will be used to track deformation fields and calculate traction stress via Traction Force Microscopy (TFM). We anticipate that diabetic fibroblasts will exhibit altered contractile profiles compared to healthy controls on stiff substrates. Furthermore, we expect that reducing substrate stiffness will decrease excessive contractile forces in diabetic fibroblasts, suggesting a potential therapeutic strategy to improve wound contraction and closure in diabetic patients.

Poster Presentation
Graduate Student

Presentation Number: 328

Presentation Title: Sustainable EPS Production from Corn Stover Using Thermophilic Bacterium Integrating Lignocellulose Bioconversion with Applications

Student Name: Anjali Thapliyal

anjali.thapliyal@mines.sdsmt.edu

Department of Chemical and Biological Health Sciences

Advisor: Dr. Rajesh Sani

Chemical and Biological Engineering

Abstract: Microbial exopolysaccharides (EPS) hold significant promise as precursors for nanogel-based biomaterials; however, metabolic bottlenecks and the high cost associated with lignocellulosic biomass pretreatment continue to limit their industrial-scale production. This study evaluates the capacity of a thermophilic bacterium to produce EPS directly from untreated corn stover (0.5% w/v) as a renewable lignocellulosic substrate, bypassing conventional pretreatment requirements. Bioprocess scale-up was conducted in a 30 L bioreactor at Dakota BioWorx to establish scalable production conditions. Growth kinetics were monitored through quantification of total sugar, reducing sugar, and protein concentrations to track carbon release and its metabolic redistribution towards EPS biosynthesis. Structural characterization of the extracted EPS was performed using atomic force microscopy (AFM), Fourier-transform infrared spectroscopy (FTIR), and Brunauer–Emmett–Teller (BET) analysis. A further investigation was conducted to establish the link between substrate depolymerization and polymer biosynthesis through daily assessment of lignocellulosic degradation efficiency at bench-scale reactors. Collectively, these findings establish an initial framework supporting the development of a scalable waste-to-biopolymer such as nanogel-based biomaterials, platform by positively connecting the EPS biosynthesis with both lignocellulosic depolymerization and metabolic flux dynamics.

Poster Presentation

Graduate Student

Presentation Number: 329

Presentation Title: Palladium Tetrahedral Nanoparticles` Synthesis

Student Name: Junming Yue

junming.yue@mines.sdsmt.edu

NANO&BME

Advisor: Dr. Shan Zhou

NANO&BME

Abstract: The controlled synthesis of nanoparticles remains a critical area in materials science and nanotechnology. Here, I am presenting our recent effort focusing on the precision synthesis of palladium (Pd) nanoparticles with tailored size, shape, and high structural uniformity, aimed at their potential use as building blocks for assembling long-range ordered structures with promising catalytic applications. To achieve this, we systematically investigate and optimize synthetic parameters critical to producing nanoparticles with the desired size and shape uniformity. Comprehensive characterization, including Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM), is employed to elucidate their morphological and structural properties. By uncovering the mechanisms that drive nanoparticle synthesis and self-assembly, this work aims to advance the rational design and scalable development of next-generation functional nanomaterials.

Poster Presentation

Graduate Student

Presentation Number: 330

Presentation Title: Numerical Analysis of Long-Term Stability of Planned New Excavations at SURF

Student Name: Rommel Romel Hassan

rommelromel.hassan@mines.sdsmt.edu

Geology and Geological Engineering

Advisor: Dr. Zhi Ye

Geology and Geological Engineering

Abstract: The Sanford Underground Research Facility (SURF) plans the construction of new underground excavations at the 4,850-ft level to expand research capacity. This study presents a three-dimensional numerical investigation of the planned tunnel system using a hybrid Discrete Fracture Network–Finite Element Method (DFN-FEM) modeling framework. The primary objective is to evaluate the mechanical influence of explicitly represented fracture networks on excavation response. A conventional continuum FEM model is developed and compared directly with a DFN-FEM model incorporating stochastically generated fracture sets within the rock mass. Displacement magnitudes and distributions at critical tunnel locations, including the roof and sidewalls, are quantified to assess differences in deformation behavior. In addition, excavation interaction effects are examined by comparing single-tunnel and twin-tunnel configurations under identical in-situ stress conditions. Results demonstrate that explicit fracture representation modifies local stress redistribution and displacement concentrations in the surrounding rock mass. The study establishes a structured numerical workflow for integrating DFN concepts into large-scale FEM analyses of deep underground excavations.

Poster Presentation

Graduate Student

Presentation Number: 331

Presentation Title: Evaluating and Refining Hands-On Systems Thinking and Systems Engineering Activities in Mechanical Engineering Courses

Student Name: Lucas Pierce

lucas.pierce@mines.sdsmt.edu

Leslie A. Rose Department of Mechanical Engineering

Advisor: Dr. Micah Lande, Dr. Cassandra Birrenkott

Leslie A. Rose Department of Mechanical Engineering

Abstract: Engineering programs often emphasize technical analysis in early coursework, while systems thinking (ST) and systems engineering (SE) are introduced later. As a result, students have limited opportunities to develop systems-oriented reasoning when first encountering authentic engineering problems. To address this gap, this multi-institutional project integrates and evaluates hands-on activities that introduce ST and SE principles in first-year mechanical engineering courses across three universities.

The instructional model follows a flipped approach in which students complete online modules before class and engage in structured, collaborative activities during class. This paper focuses on the refinement and evaluation of several one-hour activities designed to reinforce core ST/SE concepts through analysis, stakeholder reasoning, teamwork, iteration, and design trade-offs. A fourth activity is under development to extend these objectives through rapid prototyping and mission-driven, solution-neutral design.

Recent refinements account for differences in classroom settings and resources across institutions. Updated materials include clearer prompts, standardized assessments, and embedded reflection questions to better align hands-on experiences with targeted ST/SE learning outcomes. Effectiveness is evaluated using a mixed-methods approach, analyzing student surveys, open-ended feedback, instructor reflections, and assessment artifacts from Fall 2024 through Fall 2025 implementations.

Results indicate that students consistently perceive the activities as engaging and valuable for learning systems concepts. Instructor feedback highlights the importance of facilitation, pacing, and scaffolding to support abstraction and systems-level reasoning. These findings inform ongoing refinement and provide practical guidance for integrating ST and SE concepts into early engineering coursework.

Poster Presentation

Graduate Student

Presentation Number: 332

Presentation Title: Simulation Studies of a High-Purity Germanium-Based Gamma Imaging Detector (GeGI) for Nuclear and Medical Applications

Student Name: Noomen Belmechri
noomen.belmechri@mines.sdsmt.edu
Physics

Advisor: Juergen Reichenbacher
Physics

Abstract: High-purity germanium (HPGe) detectors provide excellent gamma-spectroscopic energy resolution and are promising candidates for advanced gamma-ray imaging systems. As part of the Germanium-based Science and Technology Advancement Research (Ge-STAR) initiative, the GeGI detector has recently been acquired at SD Mines to investigate its potential as a Compton imaging detector. In this work, Geant4 simulations are being developed to model the GeGI detector geometry and study gamma-ray interactions within the system. These simulations allow investigation of separate interaction mechanisms such as Compton scattering and photoelectric absorption and thus can provide insight into expected multistrip detector response, energy deposition spectra, and imaging capabilities for gamma-radiation and medical samples. The simulation framework will inform future experimental measurements using the GeGI detector. Ultimately, these studies guide the long-term goal of the Ge-STAR collaboration to design and optimize next-generation germanium strip detectors for gamma-ray imaging and nuclear radiation detection and medical applications.

Poster Presentation
Graduate Student

Presentation Number: 333

Presentation Title: Electromagnetic Characterization of a Novel Metal Tetrahedral Nanostructure: Insights into Chiroptical Properties and Polarization Sensitivity

Student Name: Md Kausar Hamid Miji

md.miji@mines.sdsmt.edu

Nanoscience & Nanoengineering

Advisor: Dr. Robert Anderson

Nanoscience and Biomedical Engineering

Abstract: The plasmonic behavior of nanoparticles (NPs) has been studied extensively and adopted widely across diverse fields, including physics, engineering, and biotechnology. Current research increasingly focuses on the design of sophisticated 0D to 3D plasmonic building blocks to unlock novel material properties. This work investigates the electromagnetic properties of tetrahedral bipyramidal noble metal nanoparticles using the Finite Difference Time-Domain (FDTD) technique to simulate their response. These geometrically distinct materials hold significant potential for advancing quantum information processing and quantum sensing. Future work will include characterization of the chiral response and polarization sensitivity of engineered layers comprising these bipyramidal novel 2D materials and experimental validation against physical samples of fabricated plasmonic materials.

Poster Presentation

Graduate Student

Presentation Number: 334

Presentation Title: Promising Equation of State Models for High-Pressure High-Temperature Wells

Student Name: Ibukunoluwa P. Olasesan

Paul.olasesan@mines.sdsmt.edu

Chemical & Biological Engineering

Advisor: Dr. Rajesh Shende

Chemical & Biological Engineering

Abstract: This study analyzed and compared promising Equation of State models for High-Pressure High-Temperature (HPHT) well applications. The study examined four fluid phase behavior Equation of State (EOS) models namely, (Peng-Robinson (PR), Cubic-Plus-Association (CPA), Perturbed-Chain Statistical Associating Fluid Theory (PC-SAFT) and Peng-RobinsonBabalola-Susu (PRBS). Their strengths, weaknesses, and computational efficiencies in calculating molar volumes with pressure change were rigorously analyzed using the Python program for five reservoir fluid systems: WELL 1, WELL 2, WELL 3, WELL 4 and WELL 5. PRBS, PC-SAFT, and CPA showed accurate predictions at specific high-pressure ranges between 90 and 160 MPa on the average, PRBS exhibited the lowest percentage Absolute Average Deviation (%AAD) of 21.0, followed by PC-SAFT with 28.0, followed closely by CPA with 31.8 while PR was shown to be totally unapplicable to high pressure reservoir systems as it had a %AAD of 125.4.

Artificial Intelligence (AI)/Machine Learning (ML) modelling is currently being investigated to understand the role of surfactants in high-temperature, high-pressure aqueous-phase liquefaction of agriculture & forest residue.

Poster Presentation

Graduate Student

Presentation Number: 335

Presentation Title: Upscaling injection-induced fracture slip from core-scale experiments to large-area direct shear tests

Student Name: Khomchan Promneewat
khomchan.promneewat@mines.sdsmt.edu
Geology and Geological Engineering

Advisor: Dr. Zhi Ye
Geology and Geological Engineering

Abstract: During subsurface fluid injection, increasing pore pressure can reduce the effective normal stress acting on faults or fractures, which may decrease fracture/fault shear strength and trigger injection-induced seismicity. This process is associated with several subsurface engineering applications, including carbon storage injection, geothermal energy production, and wastewater disposal. Previous laboratory studies commonly investigate this mechanism using pre-existing fractures in rock cores with inclined shear planes, producing a typical shear area of approximately 4.5 in², which enables effective control of pore-pressure distribution during fluid injection due to the small surface area. However, when considering upscaling to practical subsurface applications, larger fracture surfaces should be examined because injection pressure distribution along the fracture is an important factor influencing slip behavior. Direct shear experiments provide a simple framework for studying fracture slip by shearing two blocks under controlled normal and shear stresses, but the larger shear surface makes fluid pressure distribution more difficult to control. This study presents a simple approach to regulate pressure distribution by applying an O-ring seal along the shear plane to simulate an undrained condition. Results from the continuous injection approach show that the O-ring configuration produces similar mechanical behavior while maintaining an undrained condition over a larger shear surface of approximately 25 in², which is about 5.6 times larger than the shear area commonly used in compression shearing experiments. This approach provides a useful framework for investigating pressure distribution and slip behavior over larger fracture surfaces relevant to subsurface injection applications at relatively low cost.

Poster Presentation
Graduate Student

Presentation Number: 336

Presentation Title: Confining Pressure Effects on Elastic Modulus, Failure Envelope, and Crack Localization in Lakota Sandstone

Student Name: Ajita Bhandari

ajita.bhandari@mines.sdsmt.edu

Geology & Geological Engineering

Advisor: Zhi Ye

Geology and Geological Engineering

Abstract: Microcrack evolution governs the mechanical response of deep subsurface rock under confining pressure. In this study, we conducted multistage triaxial tests on Lakota sandstone to determine its strength, elastic parameters, and Mohr–Coulomb failure parameters (e.g., friction angle, cohesion). We then use the Particle Flow Code (PFC) under the same loading conditions to benchmark the experimental results.

The sandstone core specimen was subjected to four successive confining pressures ranging from 1000 psi to 3000 psi, with 3,000 psi representing the maximum confinement level prior to failure. At 1000 psi, the measured Young's modulus and Poisson's ratio were 33.02 GPa and 0.16, respectively. As confining pressure increased (simulating greater depth), the Young's modulus slightly decreased to 31.79 GPa, while Poisson's ratio increased to 0.20, suggesting the accumulated damage caused during the multistage loading. The derived Mohr–Coulomb shear strength parameters of the sandstone are cohesion of 33.88 MPa, an internal friction angle of 39.96° , and a friction coefficient of 0.83.

The sandstone was also modeled in PFC under similar conditions. The simulation reproduced crack initiation, propagation, and failure (tensile or shear mode) localization. Crack density increased with confining pressure, and failure localized along a dominant shear plane controlled by the applied stress state. The results indicate that the PFC simulation and experimental data are in good agreement. Overall, these findings constrain the elastic and shear strength parameters of sandstone under triaxial loading and support geomechanically modeling of deep rock formations.

Poster Presentation

Graduate Student

Presentation Number: 338

Presentation Title: Hyaluronic Acid (HA) Binding Peptide Functionalized PLGA/PCL Core-Shell Nanofibers for Endogenous HA-enriched Regenerative Wound Dressings

Student Name: Whitney Ponwith
whitney.ponwith@mines.sdsmt.edu
Biomedical Engineering

Advisor: Tugba Ozdemir
Nanoscience & Biomedical Engineering

Abstract: Wound healing in adults often leads to fibrotic scarring due to excessive extracellular matrix (ECM) deposition and myofibroblast activation, marked by elevated alpha-SMA expression. In contrast, neonatal wound healing is regenerative and associated with elevated high molecular weight hyaluronic acid (HA) and diminished α -SMA expression. Hyaluronic acid binding peptides (HABPs) can retain endogenous HA and influence ECM remodeling. Preliminary work showed a 10-fold increase in HA on HBP treated surfaces compared to non-coated surfaces. In this study, we developed degradable scaffolds by coaxial electrospinning PLGA/PCL core-shell nanofibers functionalized with HBP to retain endogenous HA and cue fibroblasts toward a regenerative phenotype.

Fabrication and Characterization: PLGA (shell) and PCL (core) fibers were formed through coaxial electrospinning using a design of experiments (DoE) approach. Morphology was characterized by SEM and core-shell structure confirmed by TEM. NaOH etching selectively degraded the shell, leaving the PCL core exposed. **Surface Functionalization:** The shell was functionalized with HBP (GAHWQFNALTVR), confirmed by Alcian Blue staining and water contact angle. **Cellular Studies:** Adult and neonatal primary human dermal fibroblasts will be comparatively studied. Immunostaining for α -SMA and collagen expression will evaluate fibroblast phenotype and HA synthase activity.

TEM confirmed the formation of core-shell PLGA/PCL nanofibers with distinct contrast between the PCL core and PLGA shell. SEM after NaOH treatment revealed controlled PLGA shell degradation, exposing the PCL core, confirmed by FTIR spectra of the carbonyl region (1765-1710 cm^{-1}) showing a shift from PLGA to PCL.

This work confirms core-shell formation of coaxial PLGA/PCL nanofibers with controllable degradation functionalized with HBP. By influencing HA retention and fibroblast behavior, we may be able to promote regenerative versus fibrotic wound healing outcomes.

Poster Presentation
Graduate Student