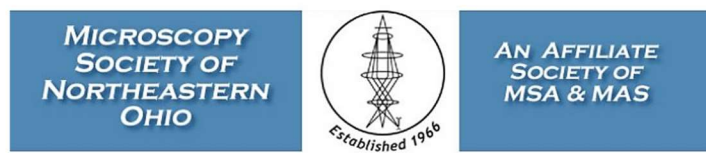


68th Annual May Conference

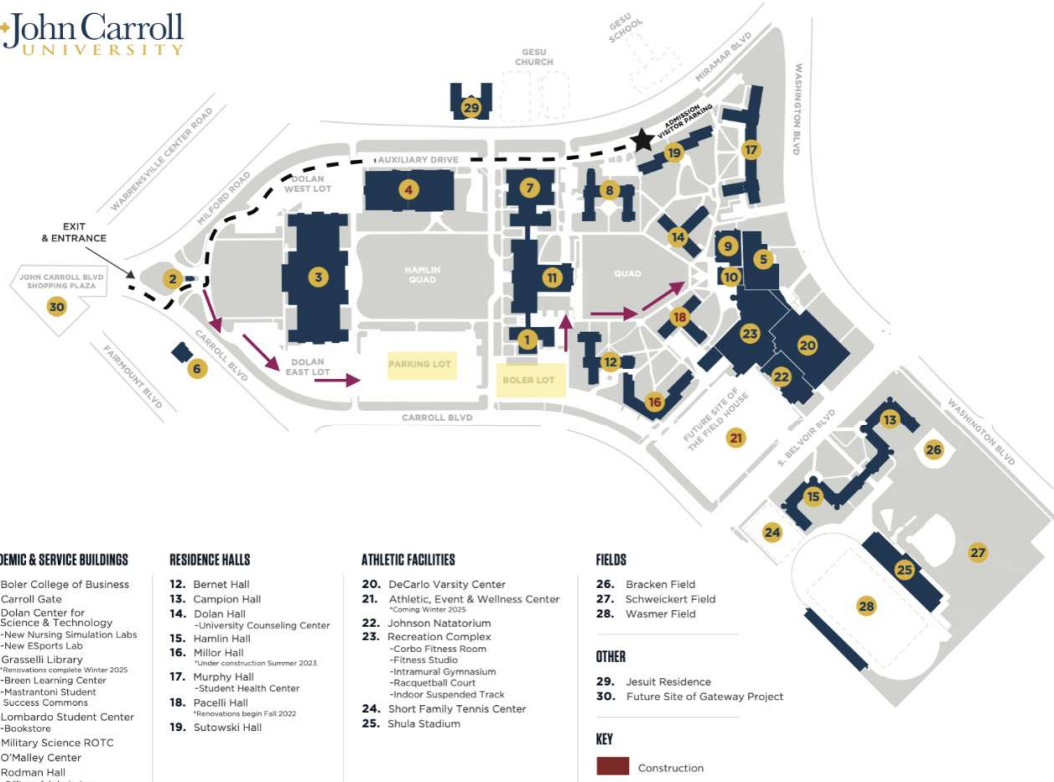
May 20, 2026

John Carroll University: Dolan Science Center
University Heights, OH

Sponsors/Partners:



John Carroll University Campus Map



PROGRAM

7:30 a.m.

Registration/Continental Breakfast:
(Edward M. & Ann Muldoon Atrium)

8:30 a.m.

Opening Remarks & MSNO 60th Birthday: (Donahue Auditorium)
Brian Perry, *ParkerLORD*
Laura Wilson, *NASA-Glenn*
Mike Nichols, *John Carroll University*

Recognition of Meeting Sponsors:
Rick Kus

8:45 a.m.

Keynote Address: (Donahue Auditorium)
Chair: Jeffery Pigott, Case Western Reserve University

Julianna Ly, *The Cleveland Museum of Art*
"Beneath the Brushstrokes: Investigating Paintings with Microscopy and spectroscopic technologies"

9:35 a.m.

Break (15 minutes): (Edward M. & Ann Muldoon Atrium)

Presentation Session I

	Session IA Dolan E130 Chair: Janet Gbur	Session IB Dolan E134 Chair: Mike Dowell	Session IC Dolan E138 Chair: Aryel Clarke
9:50 a.m.	IA-1 Allison Christy "Evaluating Crystallinity in Thermoplastic Composites" <i>NASA-Glenn</i>	IB-1 Laura Bruckman "Materials Data Science Approach to Fluoroelastomer Crystallization" <i>Case Western Reserve University</i>	IC-1 Mike Dunphy "Spectroscopic Analysis and Stability Characterization of Synthesized Nitrosylcobalamin (NOCbI), a Potential Anti-Cancer Therapeutic" <i>Walsh University</i>
10:15 a.m.	IA-2 Talya Jeter "Evaluating Cellpose for Myelinated Axon Segmentation in Histological Cross-Sections of Peripheral Nerves" <i>Case Western Reserve University</i>	IB-2 Wayne Jennings "ToF-SIMS Spectral Interpretation and Modeling for Isotopic Overlap Separation" <i>Retired, NASA-Glenn</i>	IC-2 Gourab Acharjee "The Role of Shape Commensurability in Chirality Transfer" <i>Kent State University</i>
10:40 a.m.	IA-3 Jack Edwards "Structural Motifs in Crosslinked Polyester Networks Revealed by Thermal Desorption/Pyrolysis Interfaced with Direct Analysis in Real Time Tandem Mass Spectrometry (TDPy-DART-MS)" <i>University of Akron</i>	IB-3 Hemal Weerasinghe "Reaction-Time Controlled Structural and Optical Evolution of Si-C Hybrid Carbon Quantum Dots: A Spectroscopic and Microscopic Study" <i>Case Western Reserve University</i>	IC-3 Emily Zook "Analysis of Protein-Bound Water Loss following Long-Term Stress" <i>Kent State University</i>

11:05 a.m. Break (20 minutes): (Edward M. & Ann Muldoon Atrium)

11:25 a.m. Yeager Award: (Donahue Auditorium)
 Co-Chairs: Mark Waner, John Carroll University, ACS
 Melanie Knowlton, *ParkerLORD*

"Automated Electrochemical Impedance Spectroscopy Characterization: Moving towards Autonomous, High-Throughput Laboratories by Eliminating the Data Analysis Bottleneck"

12:00 p.m. Lunch: (O'Connell Reading Room)

12:45 p.m. Poster Session: (Second Floor Hallway)

Presentation II

	Session IIA Dolan E130 Chair: Laura Wilson	Session IIB Dolan E134 Chair: Grahame Kidd	Session IIC Dolan E138 Chair: Abigail Jarosz
2:15 p.m.	IIA-1 Tony Rollet "Can We Predict Fatigue with a Digital Twin of Additive Manufacturing?" <i>Carnegie Mellon University</i>	IIB-1 Rahul Singh "Redox Mediated Wireless Heterogeneous Electrocatalysis" <i>Case Western Reserve University</i>	IIC-1 Metin Uz "Functional Platforms for Exosome Bioproduction and Isolation" <i>Cleveland State University</i>
2:40 p.m.	IIA-2 Hongchu Li "Fluorescence Sensing of Anodic Corrosion in Additively Manufactured Stainless Steel Reveals Divergent Corrosion Behavior Relative to Wrought Stainless Steel" <i>Case Western Reserve University</i>	IIB-2 Saurabh Pathak "Kinetics of Selenate Reduction Mediated by Underpotentially Deposited Cu on Polycrystalline Au Electrodes in Aqueous Perchloric Acid" <i>Case Western Reserve University</i>	IIC-2 Olivia Bogna "From Staged Moon Landings to Defunded Labs: How Communication and Outreach Can Save Science" <i>Cleveland State University</i>
3:05 p.m.	IIA-3 Janet Gbur "My 18 year Relationship with a Retained, Fractured, Nitinol Endodontic File" <i>Case Western Reserve University</i>	IIB-3 Aaron Niño Gonzaga "Water Activity Reveals Nonideal Hydration in Water-Containing Deep Eutectic Solvent" <i>Case Western Reserve University</i>	IIC-3 Danielle Latham "Tensile Expansion Microscopy (TExM) Applies Mechanical Force to Super-Resolve Fixed and Image Live Cellular Samples" <i>Case Western Reserve University</i>

3:30 p.m. Break (15 minutes): (Edward M. & Ann Muldoon Atrium)

Presentation Session III

	Session IIIA Dolan E130 Chair: Coleen McFarland	Session IIIB Dolan E134 Chair: Miroslav Bogdanovski	Session IIIC Dolan E138 Chair: Kim Fraser
3:45 p.m.	IIIA-1 Mike Nichols "Setting Out to Develop a Greener Fischer Esterification Reaction and Finding "Unusual" Organic Reaction Rearrangements Along the Way" <i>John Carroll University</i>	IIIB-1 Courtney Wagner "Magnetism and Microscopy Reveal Magnetite Magnetofossils" <i>Kent State University</i>	IIIC-1 Adnan Buxamusa "SEM Analysis of a Semiconductor PLCC Package and its Surface Mount Reflow Soldered Joint to a Printed Circuit Board" <i>Youngstown State University</i>
4:10 p.m.	IIIA-2 Jay Amicangelo "Characterization of H- π and CH-O Structures of the 1:1 Methanol-Benzene Complex Using Matrix Isolation Infrared Spectroscopy" <i>Penn State Behrend</i>	IIIB-2 Siraj Islam "Synthesis of High-Surface-Area 2D Ti ₂ CTX MXenes for Heavy Metal Removal" <i>Case Western Reserve University</i>	IIIC-2 Caroline Kromalic "Assessing the Porosity of Thermally-Cured Aerosol Jet Printed Silver" <i>Case Western Reserve University</i>

4:40 p.m.

Program/ Reception (Edward M. & Ann Muldoon Atrium)
Chair: Brian Perry, *ParkerLORD*

TRI-C Youth Technology Program

Will Canaday, *YTA Staff member*

Bell Award Presentation

Tom Steele, *SAS*

Best Student Poster Awards

Emily Graves, ParkerLORD

MSNO Student Award and Best Student Paper Awards

Laura Wilson, NASA-Glenn

Closing Comments

Laura Wilson, NASA-Glenn

2026 May Conference Planning Committee

General Committee	Jeffrey Pigott, <i>Case Western Reserve University</i> Brian Perry, <i>ParkerLORD</i> Janet Gbur, <i>Case Western Reserve University</i> Min Gao, <i>Kent State University</i> Rick Kus, <i>SAS, MSNO</i> Kim Fraser, <i>Lubrizol</i> Regan Silvestri, <i>Lorain County Community College</i> Laura Wilson, <i>NASA-Glenn</i> Mike Nichols, <i>John Carroll University</i> Tom Steele, <i>SAS</i> Emily Graves, <i>ParkerLORD</i> Melanie Knowlton, <i>ParkerLORD</i> Coleen McFarland, <i>Envantage, Inc.</i> Miroslav Bogdanovski, <i>Cleveland State University</i> Michael Fricke, <i>Akron ACS</i> Emily Benson, <i>The Cleveland Clinic</i> Mike Dowell, <i>ACCESS</i> Grahame Kidd, <i>The Cleveland Clinic</i> Narayana Bommedi, <i>Cleveland State University</i> Brett Ley, <i>Case Western Reserve University</i>
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Publicity	Kim Fraser, <i>Lubrizol</i> Min Gao, <i>Kent State University</i> Janet Gbur, <i>Case Western Reserve University</i> Jeffrey Pigott, <i>Case Western Reserve University</i> Laura Wilson, <i>NASA-Glenn</i>
Finance	Bob Williams, <i>SAS</i> Rick Kus, <i>SAS, MSNO</i>
E. B. Yeager Award	Melanie Knowlton, <i>ParkerLORD</i>

Rick Kus, *SAS, MSNO*
Lisa Ponton, *Baldwin Wallace University*
Doug Rohde, *The Cleveland Clinic*

Student Paper Awards

Min Gao, *Kent State University*
Melanie Knowlton, *ParkerLORD*
Laura Wilson, *NASA-Glenn*
Michael Fricke, *Akron ACS*
Jeffrey Pigott, *Case Western Reserve University*
Anushree Deshpande, *ParkerLORD*

Student Poster Awards

Emily Graves, *ParkerLORD*
Erica Winkler, *ParkerLORD*
Coleen McFarland, *Envantage, Inc.*
Kim Fraser, *Lubrizol*
Mike Dowell, *ACCESS*
Tom Steele, *SAS*
Emily Benson, *The Cleveland Clinic*
Tim Socash, *ParkerLORD*
Miroslav Bogdanovski, *Cleveland State University*
Greg Miller, *ParkerLORD*
Christine Jurcsisn, *De Nora*

John Bell Award

Tom Steele, *SAS*
Brian Perry, *ParkerLORD*
Melanie Knowlton, *ParkerLORD*
Doug Rohde, *Cleveland Clinic*

Program Booklet

Brian Perry, *ParkerLORD*
Rick Kus, *SAS/MSNO*
Emily Graves, *ParkerLORD*
Melanie Knowlton, *ParkerLORD*
Erica Winkler, *ParkerLORD*
Miroslav Bogdanovski, *Cleveland State University*

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Administrator	David Shultz, <i>SPE</i>
Secretary/Past President	Mike Fricke

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Councilor	Daryl Stein
Councilor	Mike Fricke, <i>Olon Ricerca Bioscience</i>
Committee Chair	Charles Kausch, <i>Lorain County Community College</i>

American Chemical Society, Cleveland Section

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Chair Elect	Michael Kenney, <i>Cuyahoga Community College</i>
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Treasurer	Krystle Reiss, <i>Multicase Inc.</i>
Councilor	Michael Kenney, <i>Cuyahoga Community College</i> Michael Levy, <i>Anachrom Analytical Specialties</i>

Ernest B. Yeager Award

Ernest B. Yeager, the Frank Hovorka Professor Emeritus of Chemistry at Case Western Reserve University, was internationally known for his pioneering contributions to the fundamental understanding of electrochemical reactions and to the development of fuel cell and battery technology. During nearly 50 years on the Case Western Reserve faculty, he mentored 80 doctorate students and 45 post-doctorate fellows, authored 270 scientific papers, and edited and co-edited 20 books. He was internationally recognized as an authority in physical acoustics and electrochemistry. His students and colleagues knew him for his uncompromising demand for excellence in research and scholarly writing. Professor Yeager, 77, died March 8, 2002, in Cleveland, Ohio, after a long struggle with Parkinson's Disease.

In 1962, the Cleveland Section of the Society for Applied Spectroscopy established the Ernest B. Yeager Award, which now consists of a certificate and a four-hundred-dollar stipend. This award is made annually by the Cleveland Sections of the Society for Applied Spectroscopy and the American Chemical Society to an outstanding undergraduate student who is attending a college or university in Northeastern Ohio, and who has demonstrated an interest in some phase of spectroscopy. The award also carries a free one-year membership in the Society for Applied Spectroscopy.

2026 Ernest B. Yeager Award Recipient

Lilly Cooper

Case Western Reserve University

"Automated Electrochemical Impedance Spectroscopy Characterization: Moving Towards Autonomous, High-Throughput Laboratories by Eliminating the Data Analysis Bottleneck"

Ernest B. Yeager Award Past Recipients:

Year	Recipient	Year	Recipient
1962	Eric A. Entemann	1995	John W. Cave
1963	John H. Konner	1996	Michael Fiorentino
1964	Sheldon J. Green	1997	Jonathan Flad
1965	Cheryl H. Miller	1998	Christopher S. Callam
1966	Dale Wingeleth	1999	David T. Clark
1967	Richard D. Ash, Jr.	2000	Adam Van Wynsberghe
1968	Jon Mynderse	2001	David C. Oertel
1969	Virginia E. Coates	2002	Richard L. Barger, Jr.
1970	Charles F. Cobb	2003	Michelle Adams
1971	Gerald R. Cappo	2004	Tiffany Leigh Copeland
1972	Donald R. Diehl	2005	Stacey Lynne Dean
1973	Fred A. Fortunato	2006	Colleen M. Burkett
1974	Douglas B. Rahrig	2007	Manasi Bhate
1975	William Hart	2008	Nikolas Joseph Neric
1976	John Havens	2009	Deacon J. Nemchick
1977	Thomas M. Leiden	2010	Rachel V. Bennett
1978	Scott A. Raybuck	2011	Daphne A. Guinn & Jennifer L. Miller
1979	Jeff Weidenhamer	2012	Jean Quenneville
1980	Alexander Kondow	2013	Yihui Chen
1981	Raymond E. Cline	2014	Jocienne Nelson
1982	Marie Zaper	2015	Kevin Budge
1983	Brian L. Cousins	2016	Ian Campbell
1984	Ka-Pi Hoh	2017	Rachel Molé
1985	Chris Scott	2018	Nicole Wagner
1986	Ann M. Mulichak	2019	Corianna Borton
1987	Rex Ramsier	2020	Ryan Reffner
1988	Joy Gorecki	2021	Eric Rachita
1989	Sheryl Tucker	2022	Megan Zins
1990	No Award Given	2023	Emma Schell
1991	Stephen C. Stone	2024	Diego Zubieta Sempertegui
1992	No Award Given	2025	Kayla Poling
1993	Baonian Hu	2026	Lilly Cooper
1994	Amy L. Lusk		

John Bell Memorial Award

John Bell was a long-time member of the Society for Applied Spectroscopy (SAS). The Northeastern Ohio Science and Engineering Fair was one of John's special interests; he took great pleasure in representing our Society's local section as a judge at this event. Unfortunately, John died in November 1994. After his death, the members of the Cleveland Section of SAS voted to honor him by establishing the John Bell Memorial Award, for the Science Fair project which best uses or illustrates a principle of spectroscopy in an innovative manner.

The 2026 John Bell Memorial Award Recipient

Nicole Rashidi

Hawken School

“Stimulating Endosomal Escape via the Ca^{2+} Ion for a DNA Origami Structure”

The 2026 John Bell Merit Award Recipient

Samipa Patek

Solon High School

“Investigating Desolvation-Synthesized Polymer Nanoparticles for Controlled Immunosuppressive Drug Delivery: A Model System for Graft-versus-Host Disease (GvHD)”

The 2026 John Bell Special Mention Award Recipient

Shreyas Eluri

Columbia Middle School

“How Does Light Move”

John Bell Memorial Award Past Recipients:

Year	John Bell Award	John Bell Merit Award	Special Mention Award
1995	Mary Elizabeth Bruce		
1996	Jonathan Parkhurst		
1997	Lavanya Kondapalli		
1998	Justine Wang	Vivek Mathur	
1999	Elizabeth Long	Kara Urbanek	
2000	Elizabeth Wood	Srinivas Kondapalli Frank Pucci	
2001	Catherine T. Burke		
2002	Mallory Horejis	Alia Evans Monica Sberna	Gabe Jakubisin Scott Brigeman
2003	Zenon Mural	Cecilia Michel Monica Benedikt	Matthew McPheeters Christina Beall
2004	Kevin Rinz	Emily C. Wirtz Sarah Lynn Martin	Gabrielle L. Petrie Zack Puskar
2005	Christine Debaz	Simone Duval Sara Yacyshyn	
2006	Ellen Napoli	Patrick Rinz Julia Juster	Brittney Williams Derek Poindexter
2007	Anna Faist	Mary Ryan Jennifer Haag	Rebecca Rabinovich Margarat Sivit
2008	Jonathan Sender	Shrey Shah Johnathan Ungvarsky	Daniel Kernan Peter Suwondo
2009	Katherine Reading	Johnathan Ungvarsky Morde Khaimov	Daniel Krentz
2010	Maddie Mooney	Katrina Feldkamp	Samuel Stroebel Leat Perez
2011	Kevin Yang	Emily Peterson	Sara Mann Jane Kim
2012	Jane Kim	Dongham Kim Maurice Ware	Paige Rogozinski Noah Nicholas
2013	Grace Gamble	Justin Boes	
2014	Alison Jin	Claire Chalkin Anjali Prabhakaran	Morgan Fink Kenna Marblestone
2015	Christine Larson	Nicholas Kernan	Lauren Zipp Ian Thompson
2016	Klaudia Sirk	Adriana Gildone	Audrey Higgins Kei Kojima
2017	Maya Dori	Natalie Haddad	Patrick McFarland
2018	Kotaro Kojima	Albert Zhu	Tingzhang Li
2019	Daniel Anthony	Henry Poduska	
2021	David Anand	Praveen Kumar	Markus Downie
2022	Jacob Rolda	Mathew Gray	
2023	Emily Meckler		
2024	Will Northup	Henrik Burda	Quinn Conley
2025	Lila Morley	Samipa Patel	Elias Sharife
2026	Nicole Rashidi	Samipa Patel	Shreyas Eluri

2026 MSNO Sponsored Award Science Fair Winners:

Northeastern Ohio Science and Engineering Fair (NEOSEF, at Lakeland Community College)

1st place—**Sophia Pinto**, *Hawken Upper*

“Characterization of LAMTOR1 and RAPTOR Protein Expression in Mammalian Cells via Western Blot, Immunofluorescence, and Lysosomal Immunoprecipitation”

2nd place—**Tristane McDermott**, *Shaker Heights HS*

“Scanning Electron Microscopy (SEM) of *Parhyale hawaiiensis* Sensory Structures”

3rd place—**Abigail Piazza**, *Hawken Upper*

“Genetically-Encoded Reporters to Optimize Mesenchymal Stem Cell Differentiation into Chondrocytes”

3rd place—**Laura Pinto**, *St. Dominic Elementary*

“Removing Microplastics with Plants”

Regional Sciences Day (at Kent State University)

1st place—**Sammy Armanazi**, *University School*

“Notch Signaling Between Arterial Endothelial Cells and Smooth Muscle Cells Regulates Angiogenesis”

2nd place—**Samuel Underwood**, *Sts. Philip and James*

“Impact of Caffeine on MCF7 Cells Shape and Growth Rate”

3rd place—**Ayat Jaffar**, Hawken School

“Optimizing Electron Transport in Organic Solar Cells using Self-Assembled Monolayers”

Poster Session

Biological Sciences Section:

1	Madison Higgins Lorain County Community College	“The Therapeutic Role of CCR5delta32 in Aids and Neuroinflammation”
2	Antonio Castro Lorain County Community College	“CCR5 inhibition and microRNA Biomarkers as a Potential Strategy for treatment and diagnosis of CTE and related Neurodegenerative Disorders”
3	Ramita Arampongpun Case Western Reserve University	“An Automated Mechanical Stretcher to Track Real-time Cell Expansion with Tensile Expansion Microscopy (TE _x M)”
4	Julie Savage Case Western Reserve University	“Micro-computed Tomography and Immunohistochemical Analysis of the Swine Carotid Sinus Nerve”
5	Myxie Tana Rogado Case Western Reserve University	“Spectroscopic Characterization of Oligonucleotide-Loaded Lipid Nanoparticles”
6	Anshuman Mohapatra Case Western Reserve University	“Chemical Interactions in Polyethylene Glycol-Induced Phase Separation Lead to an Anomalous FRET Response from a Flexible Linker-Fluorescent Protein Crowding Sensor”
7	Lydia Gibson Kent State University	“Continuous Fluorescence Microphotolysis of Stressed Cells”
8	Andrew Sarraino, Michael Dzmelyk, Courtney Axford Lorain County Community College	“Purification and Characterization of Novel Hydrolases”
9	Buraq Mohammed, Mohammed Asi, Salma Mohamed Cleveland State University	“Purification of Methanococcus Jannaschii Dihydroorotase and Co-Crystallization with Ligands”
10	Janan Alfehaid Kent State University	“Accessibility of Telomeric Overhangs to Stabilizing Small-Molecule Ligands”
11	Tharushi Ambagaspitiya Case Western Reserve University	“Photophysical Evaluation of Lanthanide Binding in Lanmodulin–inspired EF-Hand Peptides”
12	Shahrzad Dehgani University of Akron	“Beyond Pigments: Microscopic Investigation of Structural Whiteness in Calopteryx maculata for Sustainable Bio-inspired Coatings”
13	le'Jana Woodley Kent State University	“Preservation of Magnetofossils in Ancient Marine Sediments”
14	Yeshvir Yadav Kent State University	“Unrevealing the Multi-state Photoluminescence Mechanism in Red Carbon Dots: Insight from Time-Resolved Spectroscopy”
15	Zach Padula Lorain County Community College	“Discovery from the Dirt: A Tiny Earth Approach to Novel Antimicrobials”
16	Aftab Mollah Kent State University	“Targeted Delivery of Peptide Nano-drugs in Cancer Cell Therapy”

Physical Sciences Section:

17	Tae Kyong John Kim Case Western Reserve University	"Evaluation of TOF-SIMS Imaging for Semi-quantitative mapping of BODIPY-Labeled Fibronectin Surface Gradients"
18	Solomon Atta Youngstown State University	"Spray Pyrolytic Deposition and Characterization of CdTe-Based Thin Films"
19	Sandra Boakye Youngstown State University	"Development of Porous Polymethylmethacrylate Coatings to Act as Separator in Liquid Junction Photovoltaic Thread"
20	Samuel Snowden Lorain County Community College	"Low-Frequency Radio Search for the $\pi/2$ Pulsar"
21	Kayla Poling Case Western Reserve University	"Dual Modulation of the Anion-Driven Thermodynamic Properties of Aqueous Choline Halide-Based Deep Eutectic Solvents"
22	Kaavya Girdhar Case Western Reserve University	"Fatigue Behavior and Defect-Driven Failure in Additively Manufactured Metal Alloys"
23	Cindy Xu Case Western Reserve University	"Assessing the Visual Consistency of Printed Circuits for a Smart Prosthetic Liner"
24	Joel Linebach Case Western Reserve University	"Microscopic Characterization of Fibrillar Structure Development in Polypropylene via Multilayer Coextrusion and Drawing"
25	Aydin Ulus Youngstown State University	"Experimental and Numerical Investigation of Submerged and Free-Surface Jet Impingement Heat Transfer on a Plain Surface"
26	Tayseera Pillane Case Western Reserve University	"Development of a Circuit and Fabricated Flexible Sensor for a Smart Prosthetic Liner"
27	Shazia Deokarran Lorain County Community College	"21-cm Astronomy in a High RFI Environment"
28	Samuel Nyarko Osei Cleveland State University	"Computational Modeling of Microfluidic Emulsifying Devices"

Keynote Presentation

Beneath the Brushstrokes: Investigating Paintings with Microscopy & Spectroscopy Technologies

Julianna Ly

The Cleveland Museum of Art
Cleveland, OH

Conservation sits at the intersection of art and science as conservators utilize advanced analytical techniques to deepen our understanding of cultural heritage. Microscopy and spectroscopy play a critical role in this work, enabling conservators to visualize subsurface layers invisible to the naked eye and identify artists' compositional changes. These methods also support the identification of organic and inorganic materials that comprise paintings including pigments, binders, supports, and restoration layers, contributing to our understanding of artistic practice and the history of intervention. In this keynote, Julianna Ly, Associate Conservator of Paintings at the Cleveland Museum of Art, will explore how collaborative research between conservators and scientists expands our understanding of paintings in the CMA collection. This talk will highlight not only the power of scientific tools in conservation, but also the importance of interdisciplinary partnerships in advancing the field and enriching our engagement with works of art.

Presentation IA-1

Evaluating Crystallinity in Thermoplastic Composites

Allison J. Christy, Sandi G. Miller, Meelad Ranaiefar

NASA Glenn Research Center
Cleveland, OH

allison.christy@nasa.gov

Polymer matrix composites (PMCs) offer many benefits for the aerospace industry due to their potential for weight reduction when compared to metal or ceramic based materials. Most PMCs currently in flight use thermoset matrices, however, thermoplastic resins are being explored as alternatives due to their ability to be remelted, which is of particular interest due to the potential for in-situ repair and manufacturing required in space.

Most thermoplastic resins are semicrystalline polymers. The properties of semicrystalline thermoplastics are largely influenced by their crystallinity, which can vary due to many factors including thermal treatments, environmental conditions, and mechanical deformation. Monitoring the crystallinity of thermoplastic composites is key to ensuring these materials reliably meet the high demands required by space exploration.

This talk discusses the use of multiple techniques such as Polarized Light Optical Microscopy and Fourier-Transform Infrared Spectroscopy to characterize the crystallinity in various thermoplastic composites, including carbon fiber reinforced PMCs and novel bio-based Martian and Lunar regolith composites designed for in-situ manufacturing. This work aims to provide the fundamental data necessary to understand the effects of crystallinity on thermoplastic PMCs, which is key to advancing their use in space applications.

Presentation IA-2

Evaluating Cellpose for Myelinated Axon Segmentation in Histological Cross-Sections of Peripheral Nerves

Talya Jeter¹, Mallika Singh¹, Jennifer D'Silva¹, Aniya Hartzler¹, Harrison Fazzone², Evan Merzon², Jennifer Coleman^{1,4}, Nicole Pelot², Warren Grill², Andrew Shoffstall^{1,3}

¹ Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH

² Department of Biomedical Engineering, Duke University, Durham, NC

³ Cleveland VAAPT Center, Cleveland, OH

⁴ Department of Pathology - Division of Anatomic Pathology, University Hospitals, Cleveland, OH

taj35@case.edu

High through-put histological mapping of myelinated fibers of the human vagus nerve offers ultrastructural information that can be used to create computational models of vagus nerve neuromodulation. This study validates whether there are consistent fiber counts measured by a custom Cellpose segmentation pipeline analyzing serial sections of the mid-cervical vagus trunk. Cross-sections of the human vagus nerve were cut at 5 - 10 mm intervals and immunostained with myelin basic protein (MBP) and neurofilament (NF). To resolve myelinated fibers, whole slide images were acquired at 40x magnification using an Axioscan Z7 digital slide scanner (ZEISS, Oberkochen, Germany). Images were processed using a Dask-based workflow to generate fascicle (fiber bundle) masks, which were used to isolate regions for fiber-level segmentation. A custom-trained Cellpose model was then applied to segment individual myelinated fibers within each fascicle. The Cellpose model was trained using 41 manually annotated ground-truth patches (~87 x 87 μm) and evaluated on 20% held-out test images, achieving a mean average precision of 82.5%. To assess reproducibility across serial sections, total myelinated fiber counts were compared between 9 pairs of adjacent serial cross-sections from the cervical-mid vagus trunk. For each pair, the absolute percent difference in fiber count was calculated. Across the 9 pairs of serial cross-sections, the average absolute percent difference in fiber count was 6.5%. Thus, we show that automated fiber-level segmentation yields consistent myelinated fiber counts across adjacent histological sections of the human vagus nerve, indicating strong conservation of autonomic fiber content at micrometer-scale separations. These segmentations can be used to demonstrate distributions of unique peripheral nerve populations in addition to the vagus nerve, including but not limited to the hypoglossal nerve, the recurrent laryngeal nerve, and the spinal accessory nerve. Both the hypoglossal and recurrent laryngeal nerves showed significant large, myelinated fiber populations, which could be responsible for off-target side effects for vagus nerve stimulation. In the future, these fiber segmentations could be used to map fiber populations belonging to different branches to their respective locales in the vagus nerve, offering targeted information for vagus nerve stimulation to avoid unwanted side effects.

Presentation IA-3

Structural Motifs in Crosslinked Polyester Networks Revealed by Thermal Desorption/Pyrolysis Interfaced with Direct Analysis in Real Time Tandem Mass Spectrometry (TDPy-DART-MS)

Jack Edwards¹, Calumn Bochenek¹, Arsalaan Pathan², Justin Dye¹, James Eagan², Chrys Wesdemiotis^{1,2}

¹ Department of Chemistry, The University of Akron, Akron, OH

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α -ethylidene- δ -vinyl- δ -valerolactone (EVL) and its structural isomer 3-ethyl-6-vinyltetrahydro-2H-pyran-2-one (EVP) are synthesized from carbon dioxide and butadiene, making them potentially sustainable materials. Crosslinked networks can be formed from EVL and EVP, but present challenges for analysis due to their insolubility and complexity. Direct analysis in real time mass spectrometry (DART-MS), thermal desorption/pyrolysis DART-MS (TDPy-DART-MS), tandem mass spectrometry (MS/MS), and ion mobility mass spectrometry (IM-MS) were demonstrated to be effective methods for the analysis of EVL/EVP networks. DART-MS alone allowed for monomers and small fragments of the network to be observed. TDPy-DART-MS allowed for observation of the degradation products of the network at temperatures resulting in specific percent losses. This allowed for the identification of larger backbone fragments, giving a more complete picture of the composition of the network. With tandem mass spectrometry, the structure of these fragments could be verified, distinguishing hydrogenated and unsaturated units as well as ring-opening and conjugate addition polymerization. Ion mobility measurements allowed for further information about the fragments to be obtained through their collision cross section and packing factor values which show trends with fragment size and level of saturation. The combination of these techniques highlights their effectiveness in characterizing a complex, insoluble carbon dioxide-derived crosslinked network.

Presentation IB-1

Materials Data Science Approach to Fluoroelastomer Crystallization

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Materials data science for reliability requires large amounts of data and data types, often from disparate datastreams. This requires a different approach to data collection, handling, and curation in order to build models including data-drive models, machine learning, and graph models. Predicting durability and mitigating degradation has failed under traditional materials reliability methods, which has typically focused on pass/fail criteria for materials under accelerated exposures. When a material fails, the necessary data to understand the failure is often missing since detailed evaluations of a large enough population of samples were not performed in the reliability study. With advances in data science, deep learning, and machine reasoning, the opportunities for Data-Centric AI have expanded rapidly. The foundations of materials data science (MDS) computing, integrating distributed (e.g., Cloudera, Hadoop) and high-performance computing, neural network training engines mean that statistical and deep learning on sparse, massive, and historical datasets are possible. Study Protocols are an essential feature of robust MDS studies, where data FAIRification is enabled by an ontology (MDS-Onto), transforming messy data into linked data.

With technological advances, materials scientists have interest in materials with superior properties such as fluoropolymers. However, the properties of fluoropolymers degrade over time due to crystallization. To prevent crystallization and optimize experiments for fluoropolymers, we need to study and quantify crystallization kinetics. Traditionally, Gwyddion has been used to create masks and calculate crystallized areas in atomic force microscopy (AFM) movies. However, Gwyddion is time-consuming and requires significant user intervention. In this study, we are developing a generalized deep learning model by utilizing U-Net architecture. The U-Net architecture has the ability to extract features and precisely localize boundaries in AFM movies with different morphologies. Our generalized U-Net model is able to help identify the kinetics of polymer crystallization under various conditions for large data AFM movies.

Presentation IB-2

ToF-SIMS Spectral Interpretation and Modeling for Isotopic Overlap Separation

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Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) is a versatile and effective analysis tool with extreme surface sensitivity. ToF-SIMS data interpretation can be a challenge however. The sheer quantity of data is sometimes overwhelming, and for most spectra, only a small fraction of peaks are successfully identified accurately. This paper looks at some of the challenges of data interpretation, especially isotopic overlays, and presents a novel method to help sort out meaningful information.

Presentation IB-3

Reaction-Time Controlled Structural and Optical Evolution of Si-C Hybrid Carbon Quantum Dots: A Spectroscopic and Microscopic Study

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Carbon quantum dots (CQD) have attracted significant interest in bioimaging and nanotherapeutic fields owing to their outstanding photophysical properties and biocompatibility. Incorporation of heteroatoms such as Silicon (Si) offers an effective strategy to modulate their electronic structure and photophysical properties. However, the relationship between reaction conditions, structural properties and resulting photophysical behavior of these Si-C hybrid dots (Si-CQDs) remains insufficiently understood. In this study, we investigate reaction time as a key parameter in controlling Si incorporation and tuning properties of Si-CQD synthesized via a modified hydrothermal synthesis method. Their structural and photophysical properties were systematically investigated. Increasing reaction time promotes a progressive incorporation of Si into CQDs suggesting evolution towards quasi core-shell-like surface structure. These structural modifications result in a clear red-shift in photoluminescence and absorption, accompanied by a corresponding decrease in excited state lifetimes, indicating alteration of radiative and non-radiative recombination pathways governed by evolving surface states. Formation of quasi-spherical particles with minimal aggregation was confirmed via transmission electron microscopy. Importantly, these results establish a direct correlation between reaction conditions, heteroatom incorporation, and resulting photophysical behaviors. Preliminary fluorescence cell imaging demonstrates an efficient cellular uptake of Si-CQDs and strong emission, highlighting the potential of these Si-CQDs for future bioimaging applications. In summary, this study provides a comprehensive understanding of how reaction conditions govern structural, and photophysical properties of Si-CQD hybrid system which provides valuable design insights for the future CQD based fluorescent bioimaging probes.

Presentation IC-1

Spectroscopic Analysis and Stability Characterization of Synthesized Nitrosylcobalamin (NOCbl), a Potential Anti-cancer Therapeutic.

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Nitrosylcobalamin (NOCbl) has been shown to possess promising anti-cancer properties. NOCbl can be synthesized from hydroxocobalamin (HOCbl) and nitric oxide gas (NO) with excellent yields using proper conditions. The conversion of HOCbl to NOCbl can be monitored by both visible spectroscopy and reversed-phase HPLC. In addition, the cobalt-nitrogen bond involving the NO ligand is labile at low pH and can be monitored with visible spectroscopy. Stability after exposure to temperature and light variables was also studied to understand potential shelf-life and storage issues.

Presentation IC-2

The Role of Shape Commensurability in Chirality Transfer

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Chirality is a fundamental property observed across all length scales, with critical implications in biology, catalysis, metamaterials, and chiral sensing. Monolayer-protected gold nanoparticles provide a versatile platform for exploring both intrinsic and ligand-induced chirality. Liquid crystalline phases serve as sensitive reporter media, enabling the visualization and quantification of chirality transfer from the nanoscale. Here, we investigate chirality transfer and amplification in a room-temperature discotic nematic LC host using anisotropic gold nanoshapes (rods, discs, and prisms). We reported that how nanoshape geometry govern the efficacy of chirality transfer, supported by a predictive theoretical *modus operandi*. We further demonstrate exceptional chirality amplification, where molecular motors assembled on gold nanorods surface induce an augmented helical twisting power, coupled with stimuli-responsive control over the chiral state. In parallel, intrinsically chiral nanotriskelion architectures are explored to isolate shape-originated chirality independent of ligand contributions. Together, these results establish a unified strategy for designing tunable chiral soft materials for photonic, sensing, and plasmonic applications.

Presentation IC-3

Analysis of Protein-Bound Water Loss following Long-Term Stress

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Under normal conditions, intracellular water content is highly regulated through osmotic activity. A portion of this water, however, can be bound to intracellular proteins, rendering it osmotically inactive (OI). Here, we investigate the potential role of OI water loss in dehydration of mammalian cells following persistent stress exposure due to structural changes and aggregation of proteins. We also venture to study dehydration as a universal cellular response to long-term stress, as opposed to an apoptotic stimulus. Using a quantitative microscopy technique which combines transmission-through-dye (TTD) and the transport-of-intensity equation (TIE), we have been able to detect an increase in protein concentrations (and thus, a decrease in water content) in cells exposed to various stressors overnight, including oxidative stress-inducers and ionophores. Preliminary data taken using an analytical technique that combines Boyle-van 't Hoff analysis and TTD/TIE have shown a noticeable decrease of OI water in stressed cells. Current investigations into protein aggregation following prolonged stress using fluorescence recovery after photobleaching (FRAP) and, increasingly, continuous fluorescence microphotolysis (CFM) show delayed fluorescence recovery in stressed cells, indicating potential protein damage and aggregation. We plan to further verify these findings using a fluorescent protein aggregate tag on stressed cells and through native gel electrophoresis. Future studies into the presence of apoptotic markers using caspase and mitochondrial membrane potential probes are currently planned, with early results revealing a lack of apoptotic indicators in cells exposed to dehydration-inducing treatments.

Presentation IIA-1

Can We Predict Fatigue with a Digital Twin of Additive Manufacturing?

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We provide an overview of a recent NASA University Leadership Initiative project entitled “Development of an Ecosystem for Qualification of Additive Manufacturing Processes and Materials in Aviation”. This work demonstrated the dependence of fatigue on defect structures in AM Ti-6Al-4V and leads into our current NASA Science & Technology Research Institute “Institute for Model-Based Qualification & Certification of Additive Manufacturing (IMQCAM)” which is creating a numerical digital twin (DT) for predicting fatigue as a function of process parameters. The key ULI result that the defect number density was anti-correlated with fatigue life from a systematic variation across power-velocity space. The fatigue-based process window was much narrower compared to typical reports and explainable in terms of observed variations based on spatter rates and intermittent lack of melt pool overlap. We report on recent developments in modeling microstructure, texture and pores along with variations in heat treatment. We conclude that establishing a qualified materials process is feasible via an efficient survey of a limited domain of process space. Linking models together in the DT requires substantial effort in terms of data exchange. In terms of predictability of fatigue, the limited data to date suggests that the scatter in life is smallest in the long crack (Paris Law) regime, intermediate for short cracks and largest for crack nucleation. This provides an important background for Uncertainty Quantification (UQ), which is a major focus for the IMQCAM team and which has already revealed a significant sensitivity to compositional variations, for example.

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Presentation IIA-2

Fluorescence Sensing of Anodic Corrosion in Additively Manufactured Stainless Steel Reveals Divergent Corrosion Behavior Relative to Wrought Stainless Steel

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Additive manufacturing introduces distinct microstructures in stainless steels compared to conventional wrought counterparts. However, how these microstructural differences influence corrosion behavior across different measurement approaches remains unclear. Here, we compare the corrosion responses of additively manufactured stainless steel (AM SS304) and wrought stainless steel (SS304) using immersion-based fluorescence sensing and electrochemical Tafel analysis. Under immersion conditions, AM SS304 exhibits a higher apparent corrosion rate, as indicated by the increased release of Fe²⁺ detected via a turn-off fluorescent probe Phen Green SK (PGSK). However, Tafel measurements show that SS304 has higher corrosion currents and faster corrosion kinetics. Additionally, corrosion rates derived from Tafel analysis are approximately one order of magnitude higher than those obtained from immersion-based fluorescence measurements. Conventional electrochemical measurements provide ensemble averaged signals of corrosion processes, whereas fluorescent probes enable more direct and chemically selective monitoring of Fe²⁺ release. Together, these results highlight that AM SS304 and SS304 exhibit distinct corrosion behaviors that cannot be fully captured by a single evaluation method. More importantly, divergent trends suggest that microstructural differences introduced by the manufacturing process play a crucial role in corrosion response. These findings motivate the broader use of fluorescence-based methods to probe corrosion behavior and early-stage metal dissolution.

Presentation IIA-3

My 18 year Relationship with a Retained, Fractured, Nitinol Endodontic File

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“Oops.” That single word from eighteen years ago still resonates. It marked the moment an endodontic Nitinol file fractured within my molar during a root canal. When retrieval proved impossible, the clinical solution meant backfilling the root with gutta-percha and proceeding with a crown. At the time, I couldn't have known that five years later I would enter graduate school to spend the better part of a decade studying fatigue and fracture of that exact nickel-titanium alloy.

There is an irony in spending a PhD investigating the mechanical behavior of Nitinol, only to carry a personal reminder of its failure in my own tooth. This year, the saga reached its conclusion; the tooth was extracted to make way for an implant, providing a rare opportunity for a personal failure analysis study.

Endodontic file failure typically follows two pathways: torsional overload, where the tip binds while the shaft rotates, and cyclic fatigue, driven by alternating tension and compression of the file in curved canals. This investigation contextualizes the manufacturing of Nitinol from two decades ago, then transitions into an analysis of the extracted assembly, complete with porcelain-fused-metal crown and the embedded Nitinol fragment.

Initial stages of this work utilized non-destructive characterization. Optical microscopy documented the "as-extracted" tooth anatomy, while X-ray microscopy (XRM) provided high-resolution 3D visualization. XRM allows for precise spatial mapping, which is critical to planning fragment removal. Next steps will include scanning electron microscopy and energy dispersive X-ray spectroscopy to analyze the fracture surface and understand the failure mode.

Presentation IIB-1

Redox Mediated Wireless Heterogeneous Electrocatalysis

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A novel approach has been devised to promote heterogeneous electrocatalysis without the use of external instrumentation. It relies on the ability of a non-reactive, solution phase redox couple to “pin” the potential of an isolated electrode to induce adsorption of an electroactive species, triggering the catalytic process. An illustration of this unique phenomenon is provided using the reduction of selenate mediated by underpotential deposited Cu on Au(poly), in 0.1 M HClO₄, as a model system. In this case, a vanadium oxyanion based redox couple was used to “pin” the potential of Au(poly) negative to the underpotential deposition of Cu but positive to its bulk deposition. Unambiguous evidence for the reduction of selenate to yield an adsorbed layer of a form of Cu selenide was obtained by comparing the features observed in linear scan voltammograms in 0.1 M HClO₄, with those found earlier in our laboratories using conventional electrochemical control. A similar tactic was implemented to wirelessly reduce selenite in 0.1 M HClO₄, which yielded a single peak attributed to Se oxidation. The underlying bases of this unique phenomenon establish a new paradigm in heterogeneous electrocatalysis in which soluble redox couples regulate electrode potentials to initiate interfacial reactions in the absence of applied bias.

Presentation IIB-2

Kinetics of Selenate Reduction Mediated by Underpotentially Deposited Cu on Polycrystalline Au Electrodes in Aqueous Perchloric Acid

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The reduction of selenate, SeO_4^{2-} (aq), in 0.1 M HClO_4 solutions, induced by underpotential deposition (UPD) of Cu on polycrystalline Au electrodes was investigated using the rotating ring-disk electrode (RRDE) technique. Design and implementation of electrode potential–rotation rate protocols made it possible to determine the rates of SeO_4^{2-} (aq) reduction as a function of Cu coverage, θ_{Cu} , as determined by the Bruckenstein method (Swathirajan et al., J. Phys. Chem. 1982, 86, 2480–2485). In agreement with the results reported recently for Au(111) film electrodes (Strobl et al., Electrochimica Acta 2024, 493, 144,298), the reaction was found to proceed only for θ_{Cu} above a critical value, i.e. ca. 0.39 in this case, and the mechanism is consistent with an initial reversible formation of adsorbed Cu|SeO_4^{2-} (ads), followed by its subsequent irreversible reduction, to yield a yet to be identified species denoted as $\text{Cu}_x\text{Se(ads)}$, as the rate determining step. Best fits of the kinetic model yielded values of the equilibrium constant for adduct formation, K , and first-order rate constant for adduct reduction, k_{ET} , in the range $(2.4\text{--}45) \times 10^6 \text{ cm}^3 \text{ mol}^{-1}$ and $(0.55\text{--}30) \times 10^{-3} \text{ s}^{-1}$, respectively, which are close to those found for Au(111). This unique electrocatalytic effect has been attributed to a shift in the potential of zero charge of the bare substrate toward more negative values, induced by the metal UPD, which promotes the adsorption of the oxyanion at potentials more negative than those found for the bare substrate, making it possible to access overpotentials large enough for its further reduction to ensue.

Presentation IIB-3

Water Activity Reveals Nonideal Hydration in Water-Containing Deep Eutectic Solvent

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Deep eutectic solvents (DESs) are tunable liquids of interest as alternative electrolyte because their physicochemical properties can be adjusted through composition and controlled hydration. Water is often added to DESs to lower viscosity and improve transport, yet its thermodynamic role in these mixtures remains insufficiently understood. Here, we investigate water activity in ethaline, choline chloride:ethylene glycol (1:2), across a range of water mole fractions and temperature to characterize the thermodynamic behavior of the mixture and clarify how water is incorporated within the DES network. Water activity increased with temperature at fixed composition and showed negative deviations from ideal solution behavior at intermediate water mole fractions, indicating strong nonideal interactions between water and the hydrogen-bond structure of ethaline. Analysis of the temperature-dependent activity coefficient further showed that hydration in ethaline depends strongly on both composition and temperature. Complementary ^1H NMR measurements revealed changes in the local chemical environment with increasing water content, while TGA/DTG analysis showed progressively earlier low-temperature mass loss, consistent with changes in water binding and solvent organization. Together, these findings show that water activity reflects how water is chemically incorporated into ethaline across a wide range of compositions and temperatures.

Presentation IIC-1

Functional Platforms for Exosome Bioproduction and Isolation

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Exosomes are nano-sized vesicles secreted by the cells to maintain physiological homeostasis and are considered as potential therapeutics for injuries and/or diseases. Considered as novel therapeutic tools, exosomes have certain advantages; higher safety profile, lower immunogenicity, the ability to cross biological barriers, and avoiding complications that arise from cell transplantation. However, the most important challenges in using exosomes as therapeutics are to 1) achieve enough amount with mass-production allowing clinically relevant treatment tools, 2) isolation of exosomes with high yield. This presentation addresses the above listed challenges by focusing on the bioproduction of exosomes using conductive platforms and electrical stimulation, exosome isolation using a polymeric membrane system, and assessing the therapeutic activity of the obtained exosomes. The first part of the presentation will emphasize the graphene-based conductive platforms that were fabricated and characterized in our lab to modulate exosome bioproduction of mesenchymal stem cells via controlled structural and electrical cues. The second part of the presentation will highlight our newly designed stimuli responsive polymer-based membrane to isolate MSCs-derived exosomes with high yield and high purity directly from the cell culture media. In the last part of the talk, the therapeutic activity of the isolated exosomes on selected in vitro models will be discussed. The talk will end with concluding remarks and the future research direction of our lab.

Presentation IIC-2

From Staged Moon Landings to Defunded Labs: How Communication and Outreach Can Save Science

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Over the past year, the scientific community has faced unprecedented challenges across academia, industry, and government. Budget cuts exceeding \$1.5 billion, the cancellation of thousands of grants, and the loss of an estimated 10,000+ research positions have left laboratories and institutions struggling. At the same time, public trust in scientists is declining, driven by misinformation and a limited understanding of scientific processes.

At the root of this issue is the neglect of effective science communication and outreach, essential tools for bridging the gap between research and society. Often absent from academic curricula and professional development programs, the ability to convey the significance of one's work beyond specialized audiences is critical for sustaining funding, influencing policy, cultivating future talent, and maintaining public trust. Regardless of comfort with storytelling or public speaking, practical steps exist that can increase visibility and amplify impact, small actions that yield meaningful results.

Through highlights the measurable, personal, and societal benefits of outreach, as well as showcasing actionable strategies for scientists to expand the influence of their work, this talk demonstrates that engaging with society is not optional; it is as vital to the future of science as the research itself.

Presentation IIC-3

Tensile Expansion Microscopy (TExM) Applies Mechanical Force to Super-Resolve Fixed and Image Live Cellular Samples

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Expansion microscopy (ExM) has become an accessible, affordable approach to super-resolution imaging by embedding cells in a hydrogel which expands through osmotic swelling, achieving up to tenfold linear expansion. The enhanced spatial resolution enables nanoscale resolution with standard microscopes. However, ExM expansion factors are highly sensitive to reagent quality and technique. Further, current ExM methods require fixation, labeling, and digestion, limiting its use to non-living samples. To overcome these constraints, we developed Tensile Expansion Microscopy (TExM) in which a tensile-force iris expansion device acts on a highly stretchable double-network hydrogel. This allows live cells to grow directly upon the hydrogel surface. TExM allows for controlled, reversible expansion of live samples and extends current ExM approaches for fixed specimens. Using TExM, NIH 3T3 cells were fixed and stained for microtubules, confirming whole-cell expansion and super-resolution capability comparable to conventional ExM. We further demonstrated live-cell compatibility by culturing HeLa cells on the gel and applying stepwise expansions. Reporters for microtubules and cytosol revealed cellular responses under tensile stress. Beyond imaging, the iris-stretcher system offers a versatile platform for mechanobiology, enabling studies of protein cohesion, disassembly, and cell behavior under precisely controlled dynamic mechanical environments. Originally designed as a live-cell alternative to ExM, the iris-stretcher has broad potential across biological research, offering a tunable platform for probing protein structure, assembly, and dynamics under mechanical perturbation.

Presentation IIIA-1

Setting Out to Develop a Greener Fischer Esterification Reaction and Finding “Unusual” Organic Reaction Rearrangements Along the Way

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This presentation describes the development of a greener Fischer esterification experiment for the undergraduate organic chemistry laboratory and the unexpected mechanistic insights that emerged from that effort. A traditional macroscale Fischer esterification was redesigned into a microscale, microwave-assisted procedure to reduce reagent consumption, energy use, cost, and waste while maintaining strong pedagogical value. Compared with the conventional reflux/steam distillation experiment, the microwave approach shortened reaction times, lowered overall cost, and improved energy efficiency, aligning the experiment more closely with several principles of green chemistry.

During optimization, however, $^1\text{H-NMR}$ analysis revealed the formation of unexpected “rearranged” ester products, particularly at higher temperatures. These observations transformed the experiment from a straightforward esterification into a discovery-based investigation of organic reaction mechanisms. Additional spectroscopic analyses, including $^1\text{H-}$ and $^{13}\text{C-NMR}$ and deuterium-labeling studies, suggest that some rearrangements of primary alcohol substrates proceed via alkene intermediates rather than simple hydride-shift carbocation pathways. The presentation also connects these findings to the historical development of carbocation rearrangement theory, from Frank Whitmore’s early proposals to George Olah’s later experimental confirmation. Overall, this work illustrates how a green-chemistry redesign can simultaneously improve sustainability, lower costs, and create a richer laboratory experience centered on mechanistic reasoning and spectroscopic analysis.

Presentation IIIA-2

Characterization of H- π and CH-O Structures of the 1:1 Methanol-Benzene Complex Using Matrix Isolation Infrared Spectroscopy

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Matrix isolation infrared spectroscopy was used to characterize a 1:1 complex of methanol (CH₃OH) and benzene (C₆H₆). Co-deposition experiments with CH₃OH and C₆H₆ were performed at 17 - 20 K using nitrogen and argon as the matrix gases. Several new infrared peaks in the spectra were observed near the fundamental absorptions of the CH₃OH and C₆H₆ parent molecules and these new peaks have been attributed to CH₃OH-C₆H₆ complexes. Experiments were also performed with isotopic CD₃OD and C₆D₆ and the corresponding infrared peaks of the isotopologue complexes have also been observed. Theoretical calculations were performed for the CH₃OH-C₆H₆ complex using MP2 and CCSD(T) methods using the aug-cc-pVDZ and aug-cc-pVTZ basis sets. Full geometry optimizations followed by vibrational frequency calculations were performed for several initial starting geometries and three stable minima were found for the CH₃OH-C₆H₆ complex. Based on the structural characteristics and primary non-covalent interactions involved in these three minima, these structures represent one H- π complex and two distinct CH-O complexes. The H- π complex structure is predicted to be the lower energy structure by approximately 8 kJ/mol compared to the two CH-O structures. Comparing the theoretically predicted infrared spectra for the optimized CH₃OH-C₆H₆ complex structures to the experimentally observed infrared peaks in argon and nitrogen matrices, it is concluded that in the argon matrices only the H- π complex structure is being observed, whereas in the nitrogen matrices the H- π complex and one of the CH-O complex structures are being observed.

Presentation IIIB-1

Magnetism and Microscopy Reveal Magnetite Magnetofossils

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We showcase recent magnetofossil discoveries—emphasizing magnetic and electron microscopy results—and why magnetofossils are promising environmental recorders. Magnetotactic bacteria are prolific microorganisms that live in watery environments across the world. These bacteria produce 20-150 nm-sized crystals composed of either magnetite (Fe_3O_4) or greigite (Fe_3S_4) and align these particles into chains within their cells. The chains allow the bacteria to align with and navigate along Earth's magnetic field lines to their preferred living environment, the oxic-anoxic interface. When magnetotactic bacteria die, these crystals may be preserved as conventional magnetofossils. Conventional magnetofossils have been identified in sediments spanning the Cretaceous (~98 Ma) to the present and have been used in a variety of studies to interpret past nutrient, organic matter, and oxygen level changes in watery environments. Giant magnetofossils are larger, between 1-3 μm , and made of magnetite. Unlike conventional magnetofossils, we have no modern analog for giant magnetofossils and have not yet identified the organism(s) that makes them. To date, giant magnetofossils have only been identified within marine sediment records dating between the same Cretaceous interval (~98 Ma) and into the Quaternary (~1.8 ka). Importantly, the size and composition of magnetofossils make them readily detectable using magnetic measurements and electron microscopy. The results presented here demonstrate how these attributes make magnetofossils advantageous environmental recorders within the geologic record and shed light on mysterious giant magnetite magnetofossils.

Presentation IIIB-2

Synthesis of High-Surface-Area 2D Ti₂CT_x MXenes for Heavy Metal Removal

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Two-dimensional (2D) transition metal carbides, nitrides, and carbonitrides are known as MXenes (pronounced “maxenes”). With a controllable layered structure, high hydrophilic surface terminations, and outstanding conductivity, MXenes are emerging as promising multifunctional materials. MXenes are synthesized from the MAX phase, a ceramic material composed of transition-metal carbides, nitrides, or carbonitrides. The common structural formula of this type of ceramic precursor is M_n-1AX_n , where M stands for early transitional metals, A for group 13 elements, and X designates either carbon or nitrogen. MXenes represent a broad, largely underexplored class of materials, with a limited understanding of their structure–property relationships beyond a few well-studied members. Among these, Ti₂CT_x MXene is one of the most interesting, as it is among the thinnest MXenes. However, the number of available studies is very limited due to their limited stability at ambient temperature. This work highlights the importance of precursor design, showing that excess aluminum in Ti₂AlC significantly influences the stability and behavior of the resulting Ti₂CT_x MXene. Structural differences among MAX phases further indicate that uniform synthesis and processing strategies are not universally applicable. We demonstrate that a milder, more environmentally friendly etching approach yields Cl-terminated Ti₂CT_x MXene, which can be further modified with larger heteroatoms such as sulfur. The resulting material exhibits promising adsorbent performance for wastewater treatment. Overall, advances in controlled synthesis and surface functionalization could position Ti₂CT_x MXene as a strong candidate for efficient heavy metal removal in future environmental applications.

Presentation IIC-1

SEM Analysis of a Semiconductor PLCC Package and its Surface Mount Reflow Soldered Joint to a Printed Circuit Board

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Abstract – The author co-developed the Plastic Leaded Chip Carrier (PLCC) as a semiconductor (s/c) packaging form factor at Texas Instruments, Inc., Dallas, TX. A key feature of this packaging form factor was that the tinned leads were bent in a J-shape and tucked under their corresponding indents in the s/c chip's encapsulating thermoplastic package.

For this form factor to be released as usable s/c packaging by the electronics industry, the author ensured that prototypes could easily be surface mount reflow soldered onto a printed circuit board (PCB) as part of the industry's standard manufacturing process.

The success of the work conducted by the author led to its world-wide adoption as one of the industry standards for packaging higher density s/c chips by the Joint Electron Devices Engineering Committee (JEDEC) Solid State Technology Association—a global standards-setting leader for the microelectronics industry.

The cross-sectional SEM analysis of the successful reflow soldered joint is presented here.

Presentation IIC-2

Assessing the Porosity of Thermally-Cured Aerosol Jet Printed Silver

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Additively-manufactured materials commonly have defects that can compromise the bulk material properties. Aerosol jet printing, an additive manufacturing technique for flexible electronics, often introduces pores into the printed functional material that hinders their beneficial electrical properties. This work sought to quantify the porosity of thermally-cured silver deposited with aerosol jet printing. A particle-free silver ink was used to fabricate samples. Four samples were cured in an oven for four hours, each at a different temperature (i.e., 120, 150, 175, or 200°C). Characterization included digital optical microscopy to examine samples and electrical resistance measurements to compare the conductance of cured silver under different processing conditions. Cross-sections of the samples were viewed using focused ion beam scanning electron microscopy (FIBSEM), and porosity was measured using ImageJ Weka segmentation of FIBSEM images. Porosity decreased from 34-38% at 120°C to 17-21% at 200°C, which was consistent with increasing electrical conductance values with increasing temperature (0.33 ± 0.120 S at 120°C to 0.56 ± 0.309 S at 200°C). Results from this work confirmed the expected relationships between thermal processing of printed silver, the resulting microstructure, and the electrical performance of the material.

Poster Number One

The Therapeutic Role of CCR5 Δ 32 in Aids and Neuroinflammation

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HIV-1 causes AIDS by infecting cells through the CD4 receptor and the co-receptors CCR5 or CXCR4. While most people become seropositive six weeks after exposure, some individuals known as Exposed Seronegative (ESN) do not. Others become seropositive but do not progress to AIDS, a group referred to as Long-Term Average Non-Progressors (LTANPs). These outcomes are often linked to a naturally occurring mutation called CCR5 Δ 32. This 32 base-pair frameshift mutation produces a truncated protein that is not detected on the cell membrane. Previous research illustrates a down-modulation of full length CCR5 and CXCR4 proteins, rendering them absent from the cell surface. ESN individuals are often CCR5 Δ 32 homozygous, while many LTANPs are heterozygotes, suggestive of hybrid vigor. Additionally, individuals who are heterozygous are less likely to suffer from HIV-Associated Neurological Disorder (HAND). CCR5 was further identified as a treatment target in the Berlin patient resulting in a functional cure. Based on mounting evidence establishing CCR5 Δ 32 as an emerging gene therapy target a lentiviral vector system was used to create viral particles containing the mutation. Three different alleles of CCR5 were constructed: wild-type, CCR5 Δ 32, and a mutagenized version called CCR5 Δ 33. The CCR5 Δ 33 variant was specifically designed to test whether the deletion itself or the frameshift is responsible for down-modulating surface expression. HEK 293 cells were treated with particles; cell survival and morphology were assessed. Surface receptor expression will be analyzed using flow cytometry. This study will investigate whether these viral particles have the ability to control HIV replication and ameliorate neuroinflammation.

Poster Number Two

CCR5 inhibition and MicroRNA Biomarkers as a Potential Strategy for Treatment and Diagnosis of CTE and Related Neurodegenerative Disorders

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Chronic neuroinflammation is a central feature of many neurocognitive and neurodegenerative disorders and contributes to synaptic dysfunction, neuronal injury, and cognitive decline. Chronic Traumatic Encephalopathy (CTE), a condition associated with repetitive head trauma, remains particularly challenging due to the lack of reliable diagnostic methods prior to postmortem analysis.

MicroRNAs (miRNAs), small non-coding RNA molecules involved in gene regulation, have emerged as promising candidates for minimally invasive biomarkers due to their roles in inflammatory signaling, neuronal function, and synaptic plasticity. Altered miRNA expression patterns have been identified in CTE and related neurodegenerative conditions, suggesting their potential utility in early detection and disease monitoring.

In parallel, the chemokine receptor CCR5 has been identified as a key regulator of neuroinflammatory signaling and neuronal plasticity. Increased CCR5 activity has been associated with enhanced inflammation and impaired cognitive function, while CCR5 inhibition has been shown to reduce neuroinflammation, preserve synaptic plasticity, and improve cognitive outcomes in preclinical models.

This project proposes a theoretical, literature-guided framework in which CCR5 inhibition—via pharmacologic antagonists, gene-editing approaches, or other molecular strategies—is explored as a potential therapeutic intervention for neuroinflammation in CTE and related neurocognitive disorders. In parallel, miRNA profiling is proposed as a complementary strategy for early detection and therapeutic monitoring. Together, this combined approach highlights a potential pathway toward improved diagnosis and targeted treatment of neuroinflammatory neurodegenerative diseases.

Poster Number Three

An Automated Mechanical Stretcher to Track Real-time Cell Expansion with Tensile Expansion Microscopy (TEXM)

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Conventional expansion microscopy (ExM) can increase the effective resolution of imaging using water uptake to expand a sample above the diffraction limit; however, osmotic ExM involves labor-intensive protocols, requires fixation that can lead to physical distortions to sample, and signal degradation. To overcome these challenges, we have developed a novel electromechanical platform that physically expands cells using tensile force to achieve high-resolution imaging. Our tensile ExM (TEXM) system integrates an iris-based mechanical stretcher controlled using a stepper motor and micro-controller chip along with a Python-automated data acquisition to apply precise, uniform tensile force to cells cultured on a stretchable hydrogel. Here, we detail our system design, electronics, and high-fidelity feature tracking of nano-sized fiducial markers within the hydrogel during expansion using optical microscopy. The iris-expansion device was fabricated using cost-effective 3D printed and laser cut components. A PCB-controlled stepper motor drives a belt to actuate the TEXTM device arms, expanding the hydrogel sample held by grippers. A Python script automates the experiment by controlling the expansion system via a microcontroller and executing an image processing workflow. The workflow uses a gradient-based software autofocus with a Tenengrad function, image segmentation, and a nearest neighbor algorithm to track fiducial markers, which eliminates manual focusing and thereby improves efficiency. Overall, our TEXTM system provides a robust framework for investigating the real-time dynamics of cellular components under mechanical stress, yielding new insights into fundamental biophysical questions [1].

[1] Venkataramani, V., Latham, D. R., Arampongpun, R., Zammali, M., Shrikanth, T., Mohapatra, A., Guerrero, J. A., Eguiluz, R. C. A., Mathur, D., Sanchez, L. M., & Kisley, L. (2026). Tensile expansion microscopy applies mechanical force to super-resolve fixed and image live cellular samples. bioRxiv : the preprint server for biology, 2026.02.20.707066. <https://doi.org/10.64898/2026.02.20.707066>

Poster Number Four

Micro-computed Tomography and Immunohistochemical Analysis of the Swine Carotid Sinus Nerve

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Hypertension occurs in nearly half of US adults and was a contributing cause of over 600,000 deaths in 2023. Baroreflex activation therapy (BAT) uses an implanted device to deliver electricity to the carotid sinus to modulate neural activity, harnessing the body's baroreceptor reflex to lower blood pressure. However, BAT has shown mixed results, mainly due to difficulty in avoiding nearby nerves. While the basic anatomy of the CSN is known, it is very small and multifasciculated and is difficult to investigate by dissection alone. Its size and proximity to nearby nerves makes clinical device design complicated. Preclinical BAT studies are often performed in pig models. Swine CSNs have not been well documented or described. We have combined microdissection, μ CT imaging with contrast and histology to identify and analyze the swine CSN, its branching, and its interaction with nearby anatomy. This anatomical study will inform clinical device development.

Poster Number Five

Spectroscopic Characterization of Oligonucleotide-Loaded Lipid Nanoparticles

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Lipid nanoparticles (LNPs) are becoming a versatile and transformative class of therapeutic delivery systems, driven by their clinical success in COVID-19 vaccines and expanding applications in the efficient and targeted delivery of nucleic acids. Specific targeting, cellular uptake, and payload release of LNPs are strongly influenced by their size, distribution, and composition, underscoring the need for robust analytical characterization techniques to better understand and optimize these LNP systems. Although optical and spectroscopic techniques have been widely used to evaluate LNP size, distribution, morphology, and payload encapsulation, a clearer, molecular-level understanding of interactions between LNP components and their solvent environments is needed. In this study, we utilize NMR spectroscopy as a practical and powerful approach for analyzing and characterizing LNP formulations in their near-native state. We demonstrate that NMR provides molecular-level insight into lipid, payload, and solvent behavior in LNPs. Ongoing work is focused on extending these studies towards a deeper, mechanistic understanding of how lipid-lipid, lipid-payload, and lipid-solvent interactions influence LNP formation and delivery, which will be used to guide the development of next-generation LNP therapeutics.

Poster Number Six

Chemical Interactions in Polyethylene Glycol-induced Separation Lead to an Anomalous Fret Response from a Flexible Linker-Fluorescent Protein Growing Sensor

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The cellular cytosol is a crowded environment. Biomolecular Förster resonance energy transfer (FRET) sensors have been developed to measure crowding in cytosol mimics comprised of synthetic polymers such as polyethylene glycol (PEG) and Ficoll that impart an excluded volume effect. In the current study, we explore the unsolicited role of PEG in driving the phase separation of a protein crowding sensor, AcGFP1/mCherry-FRET crowding helix 2 (CrH2), into fluorescent puncta. We also evaluate a DNA-based crowding sensor (CrD) with an Alexa488/Cy5 FRET pair that does not form puncta under the same crowding conditions unless cationic polymers are present in the mixture. Using fluorescence recovery after photobleaching imaging, we uncover the liquid-like physical properties of the PEG-induced puncta. Two-color fluorescence microscopy imaging reveals crowder-induced inhomogeneity, concentration variations, and partition coefficient across the dilute and dense phases of the liquid puncta, which remain largely underexplored in bulk fluorometry measurements. Thus, the average crowding sensor response may originate from an aqueous biphasic system, reporting an erroneous average response instead of distinct levels of crowdedness. A comparison of excluded volume effects conferred by Ficoll and PEGs of various molecular weight ranges shows the influence of size, concentration, excluded volume, and chemical composition on the CrH2 sensor response. Overall, we determine the biophysical mechanisms underlying PEG-induced condensation of CrH2 and demonstrate that CrD serves as an alternative that does not undergo phase separation in vitro under the same conditions.

Poster Number Seven

Continuous Fluorescence Microphotolysis of Stressed Cells

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We examined the mobility of cytoplasmic proteins in cells under stress. Stress has been induced in cultured cells in various ways: by disrupting ion balance with amphotericin B and gramicidin, inducing oxidative stress with menadione, inhibiting the sodium-potassium pump with ouabain, and using the tubulin-depolymerizing drug colchicine. Mobility was measured using a variant of fluorescence recovery after photobleaching (FRAP) microscopy known as continuous fluorescence microphotolysis (CFM). We apply CFM to cells whose cytoplasmic proteins were stained with carboxyfluorescein succinimidyl ester (CFSE). A small submicrometer area is continuously illuminated with a 488 nm laser at medium intensity. As bleached molecules are being replaced by diffusion with previously unexposed ones, fluorescence shows a steady decline whose rate reflects molecular mobility. We found that even sub-apoptotic doses of reagents produce a significant decrease in protein mobility. This constitutes a novel and unexpected finding and may have implications for our understanding of cell stress and damage.

Poster Number Eight

Purification and Characterization of Novel Hydrolases

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Hydrolases are enzymes that use water to break chemical bonds, serving vital biological functions like breaking down carbohydrates. Thousands of understudied enzymes have known structures but unknown biological function. We aim to develop a reliable purification procedure for novel suspected hydrolases. Several proteins were selected from a putative hydrolase database to grow within a bacterial culture expressing target enzymes. The enzymes were then purified from bacterial extract. Currently, we are optimizing the purification procedure of each enzyme. Future research will include optimizing growth and purification workflows, as well as determining and quantifying the function of the enzymes.

Poster Number Nine

Purification of *Methanococcus jannaschii* Dihydroorotase and Co-crystallization with Ligands

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Dihydroorotase catalyzes a reversible reaction that converts N-carbamoyl-L-aspartate to L-dihydroorotate and vice versa in the third step of de novo pyrimidine biosynthesis. The products of this pathway are the pyrimidine nucleotides that are the building blocks of DNA and RNA, and for this reason the enzyme is a target to determine drugs against cancer and parasitic infections. In this experiment we used the enzyme from an archaeon, *Methanococcus jannaschii*. We used the archaeal enzyme because it shares many cellular characteristics with eukaryotes. We purified the enzyme and crystallized it with substrate analogs. We started with ready frozen cells. The purification included ammonium sulfate precipitation, a heat step, cation exchange and hydrophobic interaction chromatographies. The crystallization was done using the hanging drop method. We used 24 well plates and we greased their tops. In each well we put 500 ul of a reservoir solution in a gradient of pH and precipitant concentration. On plastic coverslips we place 1 ul of the reservoir solution, 0.5 ul of the ligand solution, and 2 ul of the protein solution and we inverted them on top of the reservoirs. We checked the crystals with an optical microscope to evaluate if they grew and to get a sense of their quality. The crystals will be used to determine the structures of the complexes and give insight into how the substrate and/or substrate analog bind to the protein and the mechanism of catalysis.

Poster Number Ten

Accessibility of Telomeric Overhangs to Stabilizing Small-Molecule Ligands

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Human chromosomes terminate in 50-300 nucleotide (nt) long single-stranded telomeric overhangs with repeating d(TTAGGG) sequences which can fold into protective tandem G-quadruplex (GQ) structures. Stabilizing GQs with small molecules inhibits telomerase activity, which has inspired considerable efforts in developing them as anti-cancer therapeutics. However, stacking of tandem GQ structures creates a complex and potentially inaccessible structure for small molecule binding. Here, we employ single-molecule fluorescence microscopy and photobleaching step analysis to quantify binding stoichiometry of a fluorescently-labeled oxazole telomestatin derivative (Cy5-7OTD) to telomeric overhangs that can form 1-6 GQs (30-162 nt long), covering a significant portion of the physiologically relevant range. We find that longer overhangs, on average, accommodate a larger number of ligands; however, at consistently lower stoichiometry than the maximum possible. Also, even in constructs that could accommodate 10-12 ligands, 6 or less ligands bind, suggesting structural compaction of stacked GQs. This was further supported by experiments showing enhanced Cy5-7OTD binding when the inter-GQ spacer was increased from 3 to 9 nt, an effect independently confirmed by ensemble fluorescence enhancement experiments utilizing N-methyl mesoporphyrin IX (NMM). A one-dimensional lattice model, describing equilibrium ligand binding to partially ordered telomeric overhangs, revealed positive cooperativity between folding of successive GQs, negative cooperativity between ligands bound opposing (top and bottom) faces of successive GQs, and reduced affinity at duplex-single strand junction. These results show how telomeric architecture governs ligand accessibility and inform rational GQ-targeted drug design.

Poster Number Eleven

Photophysical Evaluation of Lanthanide Binding in Lanmodulin–inspired EF-hand Peptides

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Lanthanides (Lns), often identified as critical materials, exhibit unique photophysical signatures, making them acceptable candidates in photonic applications. Yet, the luminescence properties of Lns remain to be fully leveraged for monitoring adsorption in separation methods. Peptides are promising ligands for recognition of Lns owing to their tunable amino acid sequences and selective coordination scaffolds. Herein, we demonstrate the binding of Lns to EF peptides derived from Lanmodulin protein from a photophysical perspective. The emissive ion series of Tb(III), Dy(III) and Sm(III) were selected, whereas their luminescence outputs were enhanced by incorporating tryptophan antennas into the EF peptide at various sequence locations. Accordingly, peptide-Ln binding events were transduced to assessable luminescence outputs by employing the phenomenon of resonance energy transfer. The binding affinities, quantum yield enhancements and energy transfer efficiencies of the emissive ions upon coordination with modified EF peptides were spectroscopically assessed and further corroborated by complementary non-photo emissive techniques. Among the investigated peptide-ion pairs, EF3 T90W peptide and Tb(III) ions demonstrated the best binding affinity and the highest energy-transfer efficiency. All peptides showed the weakest binding toward Dy(III) ions. Nevertheless, relative to the weak intrinsic luminescence of Dy(III), peptide bound Dy(III) ions generated >5000 % increase in luminescence intensity due to the energy transfer mechanism. The reproducible results further validated the effectiveness and versatility of this photophysical evaluation for binding analysis. Together, these findings establish the basis of developing luminescent probes triggered by peptide-lanthanide binding events which can be integrated into visualizing binding dynamics during separation processes.

Poster Number Twelve

Beyond Pigments: Microscopic Investigation of Structural Whiteness in *Calopteryx maculata* for Sustainable Bio-inspired Coatings

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This research investigates the mechanistic origins of structural whiteness in the pseudopterostigma of the female *Calopteryx maculata* (Ebony Jewelwing) to provide a blueprint for TiO₂-free, sustainable coatings. While titanium dioxide is the industry standard for white pigments, its use faces increasing scrutiny due to environmental impact and potential health risks. To understand how biological systems achieve high solar reflectance without toxic minerals, we employed a multi-modal microscopy approach to characterize the wing's morphology. Scanning Electron Microscopy (SEM) was utilized to image the cuticular surface, revealing a distinct wrinkled topography in the female white stigma compared to the smooth surface of the male black stigma. This surface roughness was further quantified using Atomic Force Microscopy (AFM), where 3D surface topography maps identified a vertical range of approximately 3.7 μm , facilitating light coupling and diffuse reflectance. To examine the internal architecture, Transmission Electron Microscopy (TEM) was performed on 100 nm resin sections. TEM imaging revealed a highly porous internal ultrastructure in the female stigma that drives a 50% high-reflectance signal, contrasting sharply with the non-porous, pigmented male stigma. Our findings demonstrate that the synergy between internal porosity and wrinkled surface morphology enables high-opacity structural color. By mapping these physical parameters, this study provides critical insights into biological micro-photonics for the design of next-generation, high-performance bio-inspired materials.

Poster Number Thirteen

Preservation of Magnetofossils in Ancient Marine Sediments

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Magnetofossils are the biogenic magnetic remains (20 nm - 4 μ m) of iron biomineralizing organisms such as magnetotactic bacteria (magnetotactic bacteria) and the elusive giant magnetofossil producing organisms. Giant magnetofossils are made of biogenic magnetite which is much larger and less abundant than conventional magnetofossils, however, the organism that produces the giant fossils is unknown unlike the modern magnetotactic bacteria. Magnetotactic bacteria are found along the sediment water interface in marine settings where they align with the Earth's magnetic field to find their niche within the water column. After death the magnetic particles are disarticulated from organic matter in the organism, the particles are well preserved and deposited on the bed, the structure of the particles is unknown. Magnetofossils are preserved and found in a wide range of aquatic bulk sediments in situ (within sediment) throughout geologic time, spanning the Cretaceous (97 Ma) to the Modern, although they have potentially been around since the Archean. This knowledge, combined with cheap and robust magnetic detection methods, makes magnetofossils promising biomarkers for environmental proxies in both past and modern conditions. Here, I will compare marine shelf sediments from the Cenomanian-Turonian (~94 Ma) (Holland Park (HP), VA) and the Paleocene-Eocene Thermal Maximum (PETM) (~56 Ma) (Wilson Lake (WL), NJ). These samples record global warming events, analogous to modern climate change, and contain abundant, morphologically diverse magnetofossils.

Poster Number Fourteen

Unrevealing the Multi-state Photoluminescence Mechanism in Red Carbon Dots: Insight from Time-resolved Spectroscopy

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Red-emitting carbon dots are highly sought after for applications in bioimaging and optoelectronics due to their long-wavelength emission and biocompatibility; however, a precise understanding of their excited-state relaxation remains a subject of ongoing investigation. Here we report the synthesis of high-yield r-CDs using ortho-phenylene diamine (OPD) as the precursor. Steady state optical characterization revealed a characteristic multi-band absorption profile with peaks at 537, 575, and 630 nm, and a dominant, excitation-independent dual emission at 600 and 680 nm. To decipher the underlying photoluminescence mechanism, we performed femtosecond transient absorption (TA) spectroscopy using two distinct pump wavelengths at 540 and 640 nm and a broadband white light probe. Global fitting analysis of the TA data resolved timescales tracking the complete relaxation pathway from initial excitation to ground-state recovery. Based on these findings, we propose a model that maps the internal conversion and radiative channels, providing critical insights into the carrier dynamics of OPD-based red-emitting systems. These results contribute to the rational design of efficient, narrow-emission carbon dots for advanced light-harvesting and imaging technologies.

Poster Number Fifteen

Discovery from the Dirt: A Tiny Earth Approach to Novel Antimicrobials

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This research aims to identify soil-dwelling bacteria capable of producing and secreting antibiotics that inhibit *ESKAPE*-safe pathogens (1). The goal is to discover naturally occurring antibiotic-producing bacteria that could serve as potential competitors against clinically relevant pathogens in medical treatment (2). The *ESKAPE*-safe relatives tested in this study include *Enterococcus spp.*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli*. Soil samples were collected from the Rocky River Metro Parks and subjected to serial dilutions before being inoculated onto spread plates. Individual colonies were then isolated through streak plating and subsequently tested against each pathogen to screen for antibiotic production. Bacterial isolates showing inhibitory activity underwent metabolic testing for preliminary identification. The 16S rRNA gene of each isolate was extracted and analyzed via PCR to determine species identity. Following genetic identification, the isolates were subjected to transposon mutagenesis to identify specific genes responsible for antibiotic production.

Poster Number Sixteen

Targeted Delivery of Peptide Nano-drugs in Cancer Cell Therapy

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Chemotherapeutic agents remain central to cancer treatment but are limited by severe cytotoxicity, lack of selectivity, and damage to healthy tissues. These challenges highlight the need for targeted and biocompatible therapeutic strategies. Here, we developed a non-toxic, fluorescent carbon-based nanopatform for targeted delivery of a peptide anticancer agent. The peptide was identified using phage display, an in vitro molecular evolution technique, with an RNA bait containing key recognition motifs for epitranscriptomic modifications such as m6A and m5C. This approach enabled the selection of a peptide with potential methyl reader targets. Carbon nanoparticles or carbon dots (CD) were synthesized and characterized to confirm their structural and optical properties. The peptide was successfully conjugated onto the nanoparticle surface, as validated by multiple spectroscopic analyses. Targeted delivery, the nano-constructs have folic acid on the surface, enabling receptor-mediated uptake via folate receptors overexpressed in many cancer cells. In vitro treatment of cancer cells with these hybrid nanoparticles resulted in a significant decrease in cell viability, indicating effective intracellular delivery and therapeutic action. Additionally, the intrinsic fluorescence of the carbon nanoparticles enables imaging capability, supporting their use as a theranostic platform.

Poster Number Seventeen

Evaluation of TOF-SIMS Imaging for Semi-quantitative Mapping of BODIPY-Labeled Fibronectin Surface Gradients

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Cell migration process in response to extracellular matrix (ECM) cues, called haptotaxis, is fundamental to many biological processes including tissue development, wound repair, and immune responses. Fibronectin (FN) serves as the ECM and reliable characterization of its concentration gradient is essential for evaluating cell-substrate interactions, especially at levels within the relevant “haptotaxis zone” (e.g. 1 -10 µg/mL). The limitation of the existing fluorescence-based detection is that it can only measure down to 10 µg/mL; thus in this study, Time of Flight – Secondary Ion Mass Spectrometry (TOF-SIMS) was used to probe the capability of the technique to overcome the detection limit and furthermore map out the FN gradient in microfluidic platforms. The study showed that TOF-SIMS was able to detect the presence of surrogate marked FN gradients at concentrations within the “haptotaxis zone”, offer high spatial resolution mapping using the mosaic mapping tool, and give a promising avenue for possible semi-quantitative analysis of FN gradient.

Poster Number Eighteen

Spray Pyrolytic Deposition and Characterization of CdTe-Based Thin Films

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Cadmium telluride (CdTe) thin films were deposited on stainless steel (SS 304) substrates using the spray pyrolysis technique, motivated by the simplicity, scalability, and low-cost nature of the method. CdTe films were deposited by spray pyrolysis under ambient atmosphere conditions onto stainless steel substrates heated to 350 °C. The resulting films were characterized to assess their structural and compositional properties. Scanning electron microscopy revealed continuous film coverage with a granular morphology, while energy-dispersive X-ray analysis confirmed the presence of Cd and Te as the dominant constituents. X-ray diffraction indicated the formation of polycrystalline CdTe, alongside secondary oxide-related phases attributed to oxygen incorporation during deposition in air.

The observation of tellurium oxide phases highlights the sensitivity of spray-deposited CdTe films to deposition atmosphere and surface chemistry, particularly on metal substrates. These findings are consistent with prior reports that emphasize the role of oxygen, substrate choice, and post-deposition treatments in determining film quality and functional behavior. Ongoing work is focused on extending the characterization to photoelectrochemical measurements to evaluate the photoresponse and interfacial charge-transfer behavior of the CdTe/metal system. In parallel, alternative layer configurations and surface modifications are being explored to improve control over oxide formation and interface properties.

Poster Number Nineteen

Development of Porous Polymethylmethacrylate Coatings to Act as Separator in Liquid Junction Photovoltaic Thread

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Wearable photovoltaic cells have become a promising technology due to their thinness, light weight, flexibility and portability as compared to conventional solar cells.

We are investigating an approach where the PV cell is configured into the shape of a wound fiber. A stainless 316 thread is coated with tungsten oxide and wound around a steel 302 wire in a photoelectrochemical.

This research focuses on producing a porous separator made of polymethyl methacrylate (PMMA) which acts as an electrical insulator but is permeable to redox- active ions.

PMMA was synthesized by emulsion polymerization. Characterization of the PMMA was performed using infrared spectrometry. The PMMA emulsion was dip-coated on stainless steel (SS) 302 wire and allowed to dry at 50 °C. An SEM image of PMMA coated on steel 302 was obtained. Electrical resistance was measured with a multimeter while an ionic permeability test was performed using cyclic voltammetry. The PMMA coated SS 302 wire passed both tests, exhibiting high electrical resistance yet with considerable ion permeability and redox activity.

Poster Number Twenty

Low-Frequency Radio Search for the $\pi/2$ Pulsar

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We attempt to find observational signatures of PSR B0904+77, a pulsar originally discovered in 1969. Since its initial discovery, it has not been re-detected. We use observations conducted at the Long-Wavelength Array (LWA; 10–88MHz) radio telescope in NM in June 2025 targeting the PSR B0904+77's uncertainty region. We also present a search with the Green Bank Observatory (GBO) 20-m telescope at 1.4GHz. Finally, we discuss future plans for follow-up observations using the Low-Frequency Array (LOFAR) as well as the Canadian HI Mapping Experiment (CHIME; 400--800 MHz) telescopes. Results will help us to understand the transient nature of this pulsar. This research is part of the Student Teams of Astrophysics ResearcherS – Undergraduate Pathways (STARS-UP) program working with students at two-year colleges on projects relevant to the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) Collaboration.

Poster Number Twenty-One

Dual Modulation of the Anion-Driven Thermodynamic Properties of Aqueous Choline Halide-Based Deep Eutectic Solvents

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Deep eutectic solvents (DESs) are regarded as highly tunable solvents, as their physicochemical properties can be tailored through selection of constituent components and their relative compositions. In this work, we investigate the influence of halide identity and water addition on the thermodynamic and volumetric properties of choline halide-based DESs. The density of choline halide-based DESs decreases nonlinearly with increasing water content, with trends correlated to halide ionic radii. Temperature-dependent density data reveal that the thermal expansion coefficient decreases slightly with increasing water content, indicating more stable volume behavior at higher water fractions. Excess molar volumes of the DES mixtures exhibit complex behaviors depending on the choline halide used, with both negative and positive excess molar volume observed across different water contents. These variations are linked to hydrogen bonding interactions between DES components and water molecules. Conductivity increases with water addition up to a maximum before declining, while viscosity decreases only marginally. The distinct physicochemical properties of each DES highlight the role of the halide anion in modulating the solvation environment and molecular interactions within the mixture.

Poster Number Twenty-Two

Fatigue Behavior and Defect-Driven Failure in Additively Manufactured Metal Alloys

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Additive Manufacturing (AM), particularly for metallic aerospace components, offers significant benefits in design flexibility and material efficiency. However, process-induced defects like porosity and lack of fusion are common, compromising structural integrity by reducing fatigue life. This study focuses on Ti-6Al-4V produced using laser powder bed fusion (LPBF). Specimens were subjected to four-point bend fatigue, and the resulting fracture surfaces were analyzed using scanning electron microscopy (SEM). The investigation aimed to characterize how AM process conditions—specifically laser power and scan velocity—influence the type, size, shape, and distribution of these process-induced defects observed on the fatigue fracture surface. Furthermore, powder contamination, verified by energy dispersive X-ray spectroscopy (EDS), was also identified as a fatigue crack initiation site. The fatigue performance of specimens initiating from this contamination was compared to those initiating from more typical LPBF defects. Understanding how variations in defect characteristics translate into observed fatigue behavior is crucial for optimizing manufacturing parameters to achieve improved fatigue performance in critical aerospace applications.

Poster Number Twenty-Three

Assessing the Visual Consistency of Printed Circuits for a Smart Prosthetic Liner

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To address skin breakdown caused by unequal pressure in prosthetic sockets, this research evaluates Aerosol Jet Printing (AJP) for fabricating low-profile, embedded sensor arrays. AJP is an additive manufacturing, direct-write process that deposits aerosolized metallic ink to create micron-scale, flexible circuits. Two studies were performed, which assessed print consistency: drift (deviation of print quality over a four-hour session) and repeatability (consistency of print quality across five separate days).

The printed geometries—comprising pads and connecting traces—were analyzed via optical microscopy and image analysis using a custom MATLAB script to quantify rectangularity, trace width, and overspray. Validating AJP's reliability is a prerequisite for the next phase: testing printed sensors under load and embedding them directly into socket linings. By mapping real-time data at the limb-socket interface, prosthetists can gain insights into spatial force distribution. This data-driven approach allows for highly personalized socket adjustments, significantly improving comfort and long-term mobility for amputees.

Poster Number Twenty-Four

Microscopic Characterization of Fibrillar Structure Development in Polypropylene via Multilayer Coextrusion and Drawing

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With plastic production growing exponentially, millions of tons of plastic are converted into consumer products annually. Of these, approximately 45% of these products are polyolefinic polymers, nearly half being polypropylene (PP). Given their prevalence, developing recycling and reprocessing methods that close the material loop is essential for mitigating the ecological impacts of plastic waste. Post-consumer recycled polypropylene (rPP), remains particularly underutilized due to degradation, contamination, and loss of mechanical integrity during conventional melt reprocessing. This proof-of-concept study investigates the valorization of rPP via two-dimensional (2D) multilayer coextrusion to induce fibrillar morphologies and enhance material performance. In this work, rPP was sourced from recycled micropipette tip boxes collected, cleaned, separated by color, and reground. Films were processed in a two-step methodology: 2D coextrusion (six vertical and three horizontal multipliers) and a heated draw to produce highly oriented PP films. Mechanical and thermal characterization on virgin polypropylene (vPP) and rPP revealed significant performance enhancement. Compared to undrawn controls, drawn vPP exhibited a 38x increase in 2% secant tensile modulus and a 13x increase in ultimate tensile strength, while drawn rPP demonstrated a 14x and 11x increase, respectively. Differential scanning calorimetry demonstrated increased crystallinity and melting temperatures upon increasing draw ratio, suggesting large degrees of orientation. Scanning electron microscopy confirms fibrillar architecture in the processed films.

Poster Number Twenty-Five

Experimental and Numerical Investigation of Submerged and Free-Surface Jet Impingement Heat Transfer on a Plain Surface

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Jet impingement is widely used in electronics cooling, where achieving accurate thermal predictions matters as much as experimental validation. In this work, heat transfer from a single submerged water jet and a free-surface (water-air) jet impinging on a plain surface was studied both experimentally and numerically at Reynolds numbers of 4234, 6352, 8469, and 10586. CFD simulations were carried out in ANSYS Fluent with the Realizable $k-\epsilon$ turbulence model and Enhanced Wall Treatment, selected to properly resolve near-wall velocity and temperature gradients in the stagnation and wall-jet regions. For the submerged case, average Nusselt numbers measured experimentally rose from 141.2 to 221.5 as Reynolds number increased, and CFD predictions fell within 2.2% of those values, the closest match occurring at $Re = 8469$, where deviation was only 0.18%. The free-surface condition produced somewhat lower Nu values, ranging from 125.6 to 215.1, with CFD agreement staying within 4.1%. At every Reynolds number tested, submerged jet impingement outperformed the free-surface case in convective heat transfer, a trend tied to differences in thermal boundary layer development between the two configurations. Velocity and temperature contours are included to support interpretation of the stagnation zone and near-wall thermal behavior under both conditions.

Poster Number Twenty-Six

Development of a Circuit and Fabricated Flexible Sensor for a Smart Prosthetic Liner

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Unequal pressure distribution and regions of high strain within prosthetic sockets can result in skin breakdown. To address this challenge, this work focuses on fabricating and embedding a low-profile aerosol jet printed (AJP) sensor array within a prosthetic socket liner.

The work focuses on connecting printed strain gauges to external electronics using conductive threads. Prior testing showed that 2-ply steel thread offers the highest conductivity and was used throughout. Electrical performance of each strain gauge was characterized via a two-point probe method to obtain resistance measurements, indicating functionality. To integrate the strain gauges and conductive thread, three attachment methods were investigated: copper tape, colloidal silver, and conductive epoxy. Each method was evaluated using optical microscopy to assess the quality of the strain gauges before and after testing. The most comprehensive method will be used to connect the strain gauges to the printed circuit board (PCB) through conductive threads.

Previous efforts established circuit configuration and initial signal-processing tests using off-the-shelf sensors. Building on this, current work tests each circuit channel with commercial strain gauges and pressure sensors by measuring voltage versus resistance while applying cyclic pressure to evaluate hysteresis. Once validated, printed strain gauges will be integrated into the circuit.

Future work will include testing AJP strain gauges under load, connecting the strain gauges to the circuit, and embedding them into the prosthetic lining. Mapping strain across the socket interface will improve understanding of force distribution on the residual limb, enabling customization of sockets and enhancing comfort and mobility for amputees.

Poster Number Twenty-Seven

21-cm Astronomy in a High RFI Environment

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Radio astronomy, like optical spectroscopy in astronomy, analyzes radio and spectral emissions from celestial objects to infer their properties. Spectral analysis enables the identification of elements and physical processes using established physics and chemistry. A central focus was the 21 cm line, a 1420.4 MHz hydrogen emission peak detected from the galactic plane, which signals high hydrogen concentration, aiding in mapping galactic structures. The Lorain County Community College STARS-UP research team, with Eureka Scientific, constructed a DSPIRA trapezoidal feedhorn telescope with a Raspberry Pi 400 to run GNU Radio Companion software to detect the 21 cm line, or neutral Hydrogen line, from various directions in the sky. Multiple constellation data sets collected using the trapezoidal horn were analyzed by measuring the frequency shift between the measured peak frequency and the expected frequency. This was accomplished using a galactic map and the HawkRAO VSLR to measure the motion of the constellation away from or towards Earth, which is then combined with the measured data to determine the percent error. From this process, the data was determined to be reliable as evidenced by the fact that three out of the four have relatively small percent differences in velocities.

Poster Number Twenty-Eight

Computational Modeling of Microfluidic Emulsifying Devices

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Microfluidic emulsification devices have emerged as effective platforms for the controlled generation of monodisperse droplets, with wide-ranging applications in biomedical engineering, drug delivery, material synthesis, and chemical processing. However, given the multiple flow regimes present in this type of systems, and sensitivity of the size and dispersion of the droplets to multiple parameters, such as the flow rates, phase viscosities, and channel geometries, optimizing the function of these devices is challenging. To that end we are developing computational models that allow more efficient prototyping of geometries and conditions that ensure high quality products, as well as enable accurate mapping of the emulsifying regimes within the controlling parameters.

Northeastern Ohio Science and Engineering Fair (NEOSEF) Participant

**Scanning Electron Microscopy of *Parhyale hawaiiensis* (crustacean)
Determines Sexual Dimorphism of Sensory Structures**

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Animals, from humans to bacteria, need to sense the outside world to survive. *Parhyale hawaiiensis* is a crustacean that inhabits marine environments. These animals live in waters rich in chemical signals from conspecifics, prey, and predators, suggesting that chemoreception, the detection of chemicals, is a dominant sensory modality for most malacostracan crustaceans, a large group that includes crabs, shrimp, and lobsters. In addition to chemical cues, these animals also detect mechanical stimuli, such as water motion, which provides critical information about nearby objects, movement, and potential threats.

One important sensory structure in *P. hawaiiensis* is the first antenna, which bears setae, bristlelike structures used for both chemoreception and mechanoreception. In adult males, the number of antennal segments and setae has been well characterized.

(OBJECTIVE and METHODS AND MATERIALS) Here, we use scanning electron microscopy to examine the first antenna of adult females to determine whether they differ in the number of antennal segments and setae.

(RESULTS) We find that females have fewer antennal segments than males.

(CONCLUSION) This might reflect sex-specific differences in behavior or ecological roles, e.g., males might need more sensory input for finding mates, defending territory, or detecting predators.

Northeastern Ohio Science and Engineering Fair (NEOSEF) Participant

Removing Microplastics with Plants

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Microplastics, pieces of plastic less than five millimeters long, impact water quality, harm marine wildlife, and affect human health worldwide. The use of synthetic polymers – long chains made up of many small molecules called monomers – is a method that is used for removing microplastics from water, but it results in many kinds of pollution, so other polymers could provide a biodegradable and nontoxic alternative. Natural polymers, or polysaccharides, satisfy the criteria. Some of these polysaccharides can be found in plants, such as okra and fenugreek. This experiment tested whether different water sources and water temperatures affect a plant-based polymer's ability to effectively aggregate microplastics in the water. Fresh okra was dehydrated and ground into powder. Water samples from Chagrin River and Lake Erie were collected. Four containers were used for each water source. Two of them had cold water, one had okra; and two of them had warm water, one had okra. This was done so the effects of okra on different temperatures and water sources could be observed. The samples analyzed after 30 minutes had a microplastic number range of only 38, so the hypothesis could not be tested, since no effect was observed. The samples analyzed after 120 minutes had a range of 118. This suggests that exposure time to okra is likely an important factor in microplastic removal. The results analyzed after 120 minutes for lake water temperature supported the hypothesis, but the results for water source and temperature differences for river water rejected it.

Regional Sciences Day Participant

Impact of Caffeine on MCF7 Cell Shape and Growth Rate

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People all over the world have caffeine in their daily life. Things that contain caffeine are chocolate, pop, coffee, and obviously energy drinks. This experiment will test the effects of caffeine on cells. The hypothesis states that MCF7 breast cancer cells will begin to have a change in shape or rate of cell division 24 hours after adding four concentrations of caffeine (0.5 mM, 1mM, 2.5 mM, and 5 mM) with the biggest change happening in the 5mM test group. Cells were grown in a lab at Walsh University for three weeks and then caffeine in the amounts above were added to 4 groups with a 5th group being the control. Using Microscope the following results were obtained. The cells in the 0.5mM and 1mM group appeared healthy and were splitting faster than the control group. The 2.5mM and 5mM groups started splitting faster than the control group but also were changing shape and clumping together, with the 5mM group changing the most and starting to look unhealthy. The 5mM cells were then observed to be dying because a gap between the cells could be seen. These results show that caffeine can be good for your cells in small amounts but can kill cells in large amounts. This information suggests that energy drinks with the appropriate amount of caffeine are not harmful to your cells, but drinks with too high an amount or drinking too many of those drinks can be harmful. Another cool thing is just after my experiment they released a study about how coffee/tea and caffeine is good and prevents Alzheimer's.

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