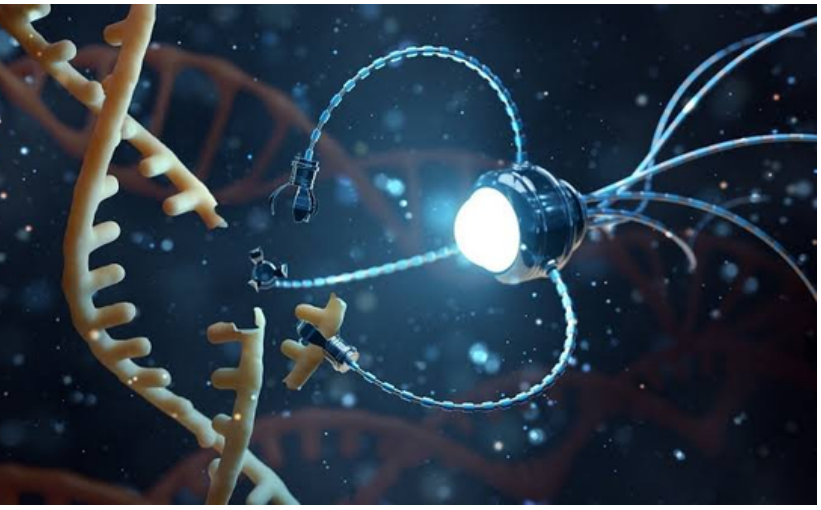
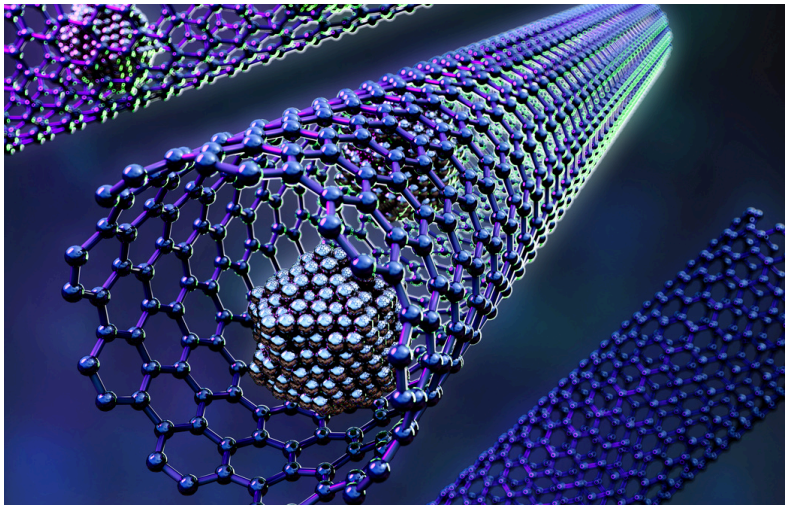
Florida Association for Nanotechnology

NanaFlorida International Conference 2026

October 2-4





FLORIDA POLY

Florida Polytechnic University
4700 Research Way,
Lakeland, FL 33805

Post on Social Media

#NIC26 **#FAN**

#NanoFlorida

Florida Association for Nanotechnology

How to Connect to Wifi

For **University of South Florida**, visit https://tinyurl.com/USFConnect for instructions.

For **Florida Polytechnic University**, visit https://tinyurl.com/PolyWifi for instructions.

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Note: Due to space constraints, speaker pages will feature condensed abstracts.

Welcome to NanoFlorida 2026



On behalf of our partners at Florida Polytechnic University and the NanoFlorida leadership team, I want to welcome you to three days of discovery, innovation, and possibility. Few fields capture the spirit of transformation more powerfully than nanotechnology. Researchers are advancing targeted therapies that can deliver medicines with greater precisions. They are engineering materials that are lighter, stronger, and more sustainable. They are improving energy storage, quantum technologies, and next-generation computing systems. What was once science fiction is rapidly becoming scientific reality. But the true promise of nanotechnology is not only in what it allows us to build. Its greatest promise is in how it can improve lives, expand opportunities, and strengthen the community we serve.

At USF, we know that most transformative discoveries often happen when disciplines converge, when scientists, engineers, clinicians, entrepreneurs, policy makers, and educators work together with shared purpose. Over the next three days, the conversations that begin here may lead to groundbreaking partnerships. New research initiatives may emerge. New companies may be launched. You may start to solve some of the most urgent challenges facing our society. To every researcher, student, entrepreneur, faculty member, industry leader, and partner here today, I wish you an inspiring and productive conference. The innovations discussed here may help shape the future of medicine, energy, computing, manufacturing, communication, and so much more. And as we say at the University of South Florida, Go Bulls!

Sincerely,

Dr. Moez Limayem, PhD
President
University of South Florida

Dear Delegates,



On behalf of USF Health and the Morsani College of Medicine, it is my distinct pleasure to welcome you to the 2026 NanoFlorida International Conference, hosted by the University of South Florida in Tampa and Florida Polytechnic University in Lakeland from October 2-4, 2026. The Morsani College of Medicine is proud to participate in this international gathering of researchers, clinicians, engineers, entrepreneurs, students, and industry leaders. The College has emerged as a dynamic and rapidly advancing academic medical institution, recognized for excellence in medical education, biomedical research, clinical innovation, and interdisciplinary collaboration. Its growing national visibility reflects the dedication of our faculty, learners, staff, and partners to advancing knowledge and improving human health. NanoFlorida 2026 exemplifies the convergence of disciplines that is redefining the future of medicine and healthcare innovation. Nanotechnology, advanced materials, biotechnology, artificial intelligence, and precision health are creating powerful new approaches to disease detection, prevention, and treatment. By bringing these fields together, the conference creates a setting in which bold ideas can move toward practical applications and meaningful impact. At the Morsani College of Medicine, we believe transformative progress occurs when disciplinary boundaries become points of connection. I encourage you to use this conference to exchange perspectives, form new partnerships, mentor emerging investigators, and identify opportunities that unite fundamental science, engineering, clinical insight, and entrepreneurship.We are especially pleased to welcome our national and international guests to the Tampa Bay region, a growing hub for academic medicine, biotechnology, and technological innovation. Together with our colleagues at Florida Polytechnic University, we are honored to host a community committed to shaping the future of nanoscience and nanomedicine.

Thank you for contributing your expertise, creativity, and leadership to NanoFlorida 2026. I hope the conference expands your professional network, stimulates new directions in research, and generates collaborations that continue well beyond these three days.

Welcome to the University of South Florida, and best wishes for an inspiring and successful NanoFlorida 2026.

Sincerely,

Charles Lockwood

Charles J. Lockwood, MD, MHCM
Dean, USF Health Morsani College of Medicine
Executive Vice President, USF Health
University of South Florida

Dear Delegates,



On behalf of the University of South Florida College of Medicine, it is my great pleasure to welcome you to the 2026 NanoFlorida International Conference, hosted by the University of South Florida in Tampa and Florida Polytechnic University in Lakeland from October 2-4, 2026. We are honored to welcome distinguished scientists, clinicians, engineers, innovators, entrepreneurs, industry leaders, students, and policymakers from across the nation and around the world. NanoFlorida provides an important forum for advancing interdisciplinary collaboration and accelerating the translation of scientific discoveries into technologies and solutions that improve human health and societal well-being. As representatives of the health sciences community, we are particularly excited about the conference's emphasis on the convergence of nanotechnology, medicine, biotechnology, artificial intelligence, and advanced materials. These rapidly evolving fields are transforming how we diagnose, prevent, and treat disease while creating unprecedented opportunities for innovation and economic growth.During the next three days, I encourage you to engage fully in the scientific sessions, keynote presentations, industry discussions, networking events, and collaborative opportunities that define the NanoFlorida experience. The interactions and partnerships formed here have the potential to spark new discoveries, strengthen research and educational programs, and accelerate the translation of breakthrough technologies into real-world impact. The University of South Florida College of Medicine is proud to support this important gathering of innovators and thought leaders. We are committed to fostering an environment that promotes excellence in research, education, entrepreneurship, and collaborative discovery. Thank you for joining us for NanoFlorida 2026. We wish you a productive, inspiring, and enjoyable conference experience and hope your time in Tampa and Lakeland will be both professionally rewarding and personally memorable.
Welcome to NanoFlorida 2026, and best wishes for a successful conference.

Sincerely,

Mark Moseley

Dr. Mark Moseley
Dean, College of Medicine
University of South Florida
On behalf of the University of South Florida College of Medicine

Dear Colleagues and Attendees,



On behalf of the Florida Association of Nanotechnology, we welcome you to the 2026 NanoFlorida International Conference. We look to provide new insights into nanomedicine applications for nanoscientists, clinicians and engineers in the areas of drug delivery, diagnostic testing and therapeutics for cancers. The NanoFlorida Conference is a unique event with a long, successful tradition of uniting student researchers from across the state of Florida to share their discoveries in nanotechnology and learn from distinguished speakers from around the United States. The intent of this conference is to converge the thinking of global leaders of nanotechnology to advance innovative solutions for their worldwide applications. This conference will feature symposia addressing advances in nanoscale interactions, nanoelectronics, nanobiotechnology, biosensing, nano-diagnostics, nanoimaging, artificial intelligence, and other innovative areas of research and their applications in a wide range of disciplines. It will also provide opportunities to network with researchers from other academic institutions and the broader nanotechnology and nanopharma industry.

Please take this opportunity to network and collaborate with other researchers in the field, which will ultimately aid in the development of a new generation of nanoscientists.

Thank you for attending and we hope you enjoy the 2026 NanoFlorida International Conference!

Sincerely,

Shyam S. Mohapatra, PhD
President, Florida Association for Nanotechnology
NanoFlorida International Conference 2026 Co-Chair

Welcome to NanoFlorida 2026



On behalf of the Florida Association for Nanotechnology, the Conference Co-Chairs, the Steering Committee, and our host institutions, the University of South Florida and Florida Polytechnic University, I am pleased to welcome you to the 2026 NanoFlorida International Conference, October 2-4, 2026.

NanoFlorida 2026 brings together a vibrant community of scientists, engineers, clinicians, entrepreneurs, industry leaders, and innovators to share advances in nanoscience and nanotechnology and to foster collaborations that accelerate scientific discovery and societal impact. We are especially committed to engaging and inspiring the next generation of innovators. The conference provides outstanding opportunities for graduate and undergraduate students to present their research, interact with leading experts, explore career pathways, and build professional networks that will support their future success.

Through keynote and plenary presentations, scientific symposia, industry forums, student-focused activities, and networking events, we encourage all participants to exchange ideas, develop new partnerships, and contribute to a dynamic and inclusive scientific community.

Thank you for joining us and for your commitment to advancing nanotechnology. We look forward to welcoming you to Florida for an exciting and impactful NanoFlorida 2026.

Safe travels, and see you soon.

Dr. Subhra Mohapatra
FAAAS, FAIMBE, FASEMFL, FNAI, FGAN
Professor and Director of Graduate Program in Molecular Medicine, USF Health
Co-Chair and Steering Committee Member
Florida Association for Nanotechnology

FLORIDA POLYTECHNIC UNIVERSITY

Attendees,



It is my pleasure to welcome you to NanoFlorida 2026 and to Florida Polytechnic University.

Florida Poly was created with a clear purpose: to bring together the disciplines, technologies and problem-solvers needed to fuel Florida's economy. That makes this University a fitting place to host a conference focused on one of the most consequential frontiers in science and engineering. Nanotechnology is already shaping what is possible across healthcare, advanced materials, electronics, energy, sensing, and computing. But breakthroughs rarely happen within a single discipline. They emerge when researchers bring different expertise to the same problem and find new ways to work across traditional boundaries. NanoFlorida creates that kind of intersection. It brings together researchers, scholars, students, educators, and industry partners to share discoveries, examine new possibilities, and build relationships that can extend well beyond this conference.

At Florida Poly, we are especially proud to welcome a community that understands the value of interdisciplinary thinking and applied research. I encourage you to make the most of your time here. Share your work. Ask difficult questions. Find the unexpected connection. And, most importantly, look for opportunities to turn ideas into impact.

Thank you for bringing your expertise and curiosity to Florida Poly. We are honored to welcome you and look forward to the breakthroughs that will emerge from this time together.

Sincerely,

Dr. Devin Stephenson
President
Florida Polytechnic University

FLORIDA POLYTECHNIC UNIVERSITY

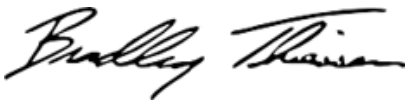
Welcome!



It is my pleasure to welcome you to the 2026 NanoFlorida Annual Meeting at Florida Polytechnic University.

There is something especially fitting about hosting a conference devoted to the science of the very small at a university with very big ambitions. Florida Poly is Florida's only public university dedicated exclusively to STEM and one of the nation's youngest universities. Our relative youth gives us the opportunity to build for the future rather than adapt to it. Across our campus, faculty and students are advancing research and education in artificial intelligence, advanced manufacturing, autonomous systems, cybersecurity, biomedical sciences and engineering, materials science, and other emerging technologies. Our university is growing rapidly, our research enterprise is expanding, and our partnerships with industry and fellow research institutions continue to deepen. In short, while NanoFlorida challenges us to think smaller, Florida Poly is determined to keep getting bigger. NanoFlorida embodies the kind of interdisciplinary discovery we value. The work represented here spans nanomedicine, nanosensors, energy, materials science, engineering, environmental applications, agriculture, artificial intelligence, and more. This meeting provides an important opportunity to share discoveries, challenge ideas, develop collaborations, and connect established researchers with the next generation of scientists and engineers. I encourage you to make the most of your time here: engage with colleagues, meet our students and faculty, explore our campus and laboratories, and discover some of the exciting work underway at Florida Poly. On behalf of our university, I thank the organizers, speakers, researchers, students, and partners who have made this meeting possible. We are proud to welcome the NanoFlorida community to our campus and excited to see the ideas and collaborations that emerge.

Welcome to Florida Poly. Welcome to NanoFlorida 2026.



Brad Thiessen, Ph.D., PStat®
Provost and Vice President for Academic Affairs
Florida Polytechnic University

FLORIDA POLYTECHNIC UNIVERSITY

Dear Attendees,



Welcome to Florida Polytechnic University and the NanoFlorida 2026 conference. On behalf of the University's Board of Trustees, I am pleased to welcome researchers, industry leaders, students, and other distinguished guests to our campus for this important gathering. Florida Poly is at an exciting point in its growth. As Florida's only public university dedicated exclusively to STEM, we are advancing strategic priorities that strengthen our academic programs, expand applied research, deepen partnerships with industry, and prepare highly skilled graduates to meet the evolving needs of Florida's economy. These efforts reflect our commitment to growing with purpose while ensuring the University continues to deliver meaningful impact for our students, our state and the industries we serve. From the Board's perspective, nanotechnology represents an important area of scientific and technological advancement with applications across many of the industries shaping our future. Florida Poly has an important role to play in this rapidly changing landscape by connecting education, research, and industry to help develop the STEM talent needed to turn new ideas and discoveries into real-world solutions. Hosting the NanoFlorida International Conference exemplifies that role. We are proud to provide a place where experts in the field can exchange ideas, build connections, and explore what is possible. I hope your time at Florida Poly is productive and inspiring, and I extend my best wishes for a successful conference.

Sincerely,

Beth R. Kigel

Beth Kigel
Chair, Board of Trustees
Florida Polytechnic University

FLORIDA POLYTECHNIC UNIVERSITY

Welcome to Florida Polytechnic University to attend NanoFlorida 2026, An International Conference!



Our campus, Florida Polytechnic University, located in Lakeland, Florida, features distinctive academic buildings, including the Innovation, Science, and Technology Building, designed by world-renowned architect and engineer Santiago Calatrava. The conference will largely take place in the Barnett Applied Research Center (BARC), named in recognition of the Barnett family's support of Florida Polytechnic University. Together, these spaces provide an appropriate setting for a gathering that brings together students and researchers to discuss the intersection of science and engineering. Nanoscience is critical because it gives researchers the ability to engineer materials and devices where structure at the nanoscale directly determines performance. This field is driving developments including advanced sensing, clean energy, environmental remediation, precision medicine, and sustainable materials. The NanoFlorida Conference brings together students, educators, researchers, and industry professionals to share discoveries, exchange ideas, and explore the many ways nanoscience can address contemporary challenges. By connecting participants across disciplines and career stages, the conference creates opportunities for collaboration, mentorship, and new research partnerships.

I hope you have a wonderful time at the conference!

Sincerely,

Ian Bentley

Dr. Ian Bentley, Ph.D.
Co-Chair of NanoFlorida 2026
Professor of Physics
Chair - Biology, Chemistry, and Chemical Engineering Department
Chair- Physics Department
https://floridapoly.edu/faculty/bios/ian-bentley/

FLORIDA POLYTECHNIC UNIVERSITY

Dear Colleagues and Participants,



It is my absolute pleasure to welcome all the participants and guests to attend the NanoFlorida 2026 Conference. This year's conference is hosted by Florida Polytechnic University at Lakeland and organized in association with the University of South Florida at Tampa. Following tradition since 2007/2008, this event is an excellent opportunity to share, exchange, and discuss advanced high-tech research that aligns with the priorities of the community, state, and nation. This conference unites student researchers, academic leaders, and industry experts across Florida and beyond to advance collaboration and education in nanoscience, nanoengineering, and nanobiotechnology. One of the objectives of this conference is to promote the needs and demands for next-generation research through discussion, engagement, and collaboration, with the aim of supporting the economic growth of Florida through collaboration and innovation. Over the years, this event has managed an outstanding program that included quality lectures, industry experts, poster sessions, and interactive discussions related to various fields of nanotechnology. This was made possible only due to the very coordinated efforts and unconditional support of the Leadership & Administration of Florida Polytechnic University, Florida Association of Nanotechnology (FAN) President, FAN Members, and Organizing Committee Members (including young scholars, co-chairs, and volunteers). I am sure these few days will be very productive and engaging for everyone. Therefore, I encourage you all to maximize the benefits by interacting with peers and experts to build a network that can be useful for your success. Once again, thank you for supporting NanoFlorida 2026 with your presence, involvement, and support. I wish you all a great time at the conference!

Sincerely,

Dr. Ajeet Kaushik, Ph.D.
Co-Chair: NanoFlorida 2026
Steering Committee Member: Florida Association of Nanotechnology
Associate Professor of Chemistry
Department of Biology, Chemistry, and Chemical Engineering
Florida Polytechnic University, Lakeland, Florida, USA
https://floridapoly.edu/faculty/bios/ajeet-kaushik/

Chairs & Committees

Conference Organizing Committee

Ajeet Kaushik, PhD
Florida Polytechnic University

Ian Bentley, PhD
Florida Polytechnic University

Shyam Mohapatra, PhD
University of South Florida

Jing Wang, PhD
University of South Florida

Subhra Mohapatra
University of South Florida

Local Organizing Committee:

Bradford Barker, PhD
Florida Polytechnic University

Pedro Manrique Charry, PhD
Florida Polytechnic University

Nathan Dawson, PhD
Florida Polytechnic University

Rishikesh Srinivasaraghavan Govindarajan, PhD
Florida Polytechnic University

Nathaniel Hermann, PhD
Florida Polytechnic University

Hyeyoung Cho, PhD
Florida Polytechnic University

Jessica Martin, PhD
Florida Polytechnic University

Student Scholars

Jessie Pate
Florida Polytechnic University

Daniel Fellows
Florida Polytechnic University

Stuti Dasgupta
Florida Polytechnic University

Joshua Morris
Florida Polytechnic University

Alexander Ishmael Vila
Florida Polytechnic University

Dan Vo
Florida Polytechnic University

Autum Hiner
Florida Polytechnic University

Daniel Lockhart
Florida Polytechnic University

Randolph Estrada
Florida Polytechnic University

Lucas Batista
Florida Polytechnic University

Zachary Saunders
Florida Polytechnic University

Michael Blake
Florida Polytechnic University

Florida Association for Nanotechnology

NanoFlorida 2026
Nano Pitch Competition



Nano Pitch Organizing Committee:

Bahar Motlagh, PhD
University of Miami

Subhra Mohapatra, PhD
University of South Florida

Swadeshmukul Santra, PhD
University of Central Florida

Sylvia Daunert, PhD
University of Miami

Ajeet Kaushik, PhD
Florida Polytechnic University

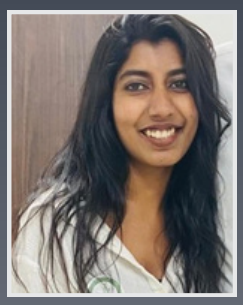
Finalists for Pitch Competition



Jorge David Tavor Castro,
CerebroCool



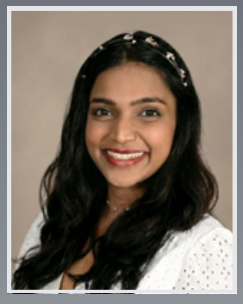
Naroa Zubimendi Varela,
EpiGuard



Antony Cyril,
SteriG



Aakash Nathani,
ECHO-NX



Akshata Yashwant Patne,
NephroZIP

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MO

FUTURE INNOVATIONS
AND RESEARCH IN MEDICINE
One Innovation at one Time

Parking Information

University of South Florida-October 2

- Internal Attendees (Any USF staff, faculty, student, who has an USF parking pass) will be expected to park in their designated parking category.
- External Attendees (anyone without an USF parking pass) will be expected to park in Lots 19 or 34. All external attendees will be expected to register their vehicle tag each day they plan to park on campus. When registering your tag, please be sure to park in any spot labeled "Daily Vistor".

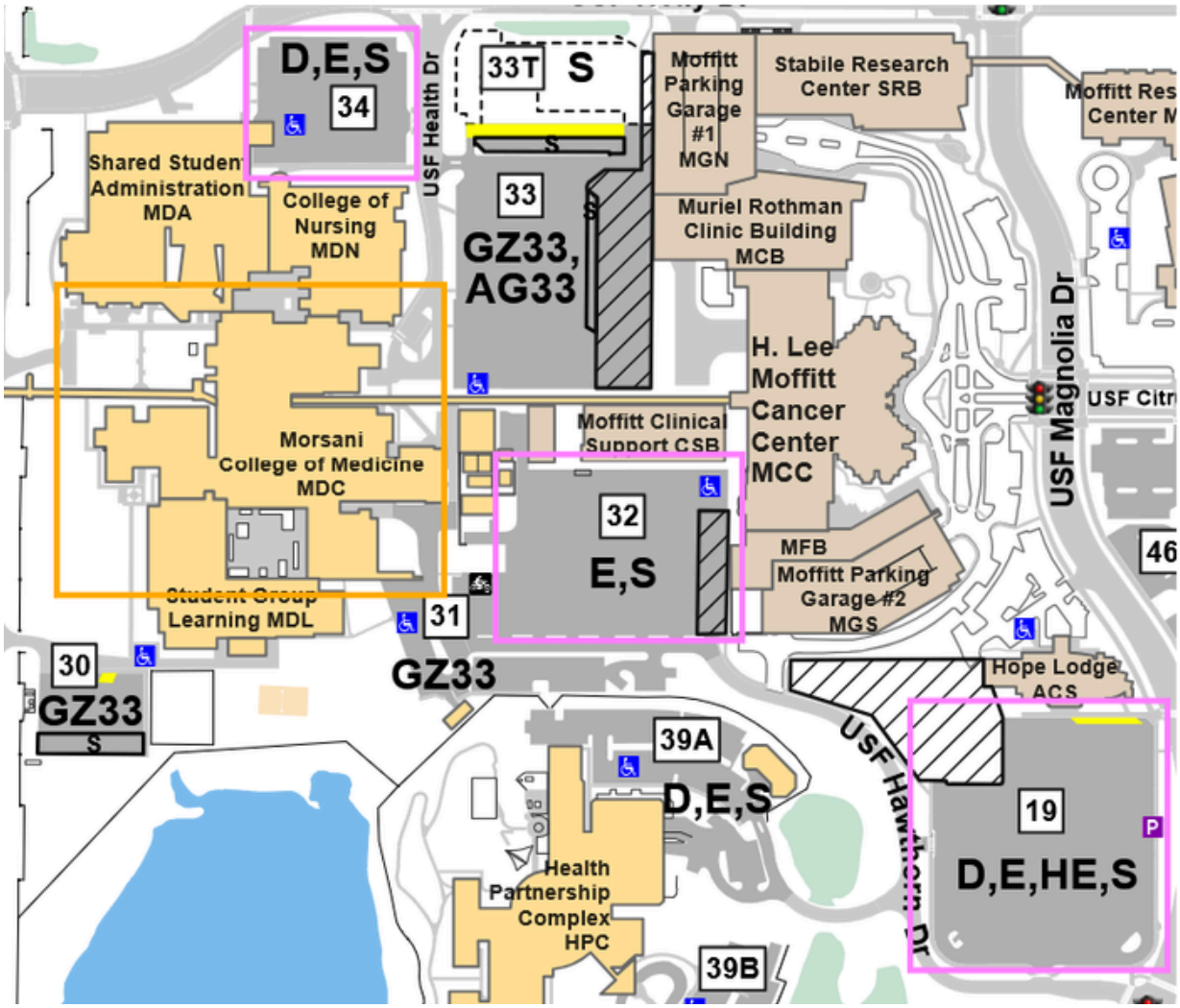
Florida Polytechnic University

- On all 3 days for the conference, parking will be free at Florida Polytechnic. Closest parking lots will be lot 2 and 4.

Parking at University of South Florida

Location: MDL 1003, USF Morsani College of Medicine

Non-USF parking permits can park in Daily Visitor lots. Can park in lot 19 and 34.



Parking at Florida Polytechnic University

Location: Barnet Applied Research Center (BARC)

Can park in lots 2 and 4 (free parking)



2026 NanoFlorida International Conference

October 2-4, 2026

University of South Florida & Florida Polytechnique University

Friday, October 2 (USF)		
1.00– 4.30 PM	**University of South Florida, MDL 1003** *Moderators: Drs. Shyam Mohapatra & Larry Hall*	
1:00 – 1:30 PM	**Welcome and Introduction**	
1:30-1.35 PM	**Shyam Mohapatra**	
1:35-1:45 PM	**Dr. Mark Mosley's Welcome Remarks**	*Chairman of Department of Internal Medicine* *University of South Florida*
1:45-1:50 PM	**Introduction to President Limayem**	**Dr. Shyam Mohapatra**
1:50-2:00 PM	**President Limayem's Welcome Remarks**	
2:00-3:00 PM	**Keynote by Prof. Robert Langer,** *"From nanotechnology to mRNA vaccines: How overcoming skepticism and barriers led to new cancer treatments and ways to tackle a global health challenge"*	*David H. Koch Institute Professor, Massachusetts Institute of Technology, Boston, MA*
3:00-3:30 PM	**Dr. Larry Hall** *"AI & Health: Promises and Perils"*	***Professor & Assoc Dean of Research*** *University of South Florida, Bellini College of Artificial Intelligence, Tampa, FL*
3:30-4:00 PM	**Dr. Yang Yang** *"Nanocarbon Technology for Advanced Biofuel & Chemical Conversion"*	***Professor,*** *University of Central Florida, Orlando, FL*
4:00-4:30 PM	**Dr. Anworul Kabir** *"Survival-aware Representation Learning from Omics for Cancer Prognosis & Treatment"*	***Asst Professor*** *University of South Florida, Bellini College of Artificial Intelligence, Tampa, FL*
Travel to Florida Polytechnique University		
6:00-7:30 PM	*Session 2: "Crossing the chasm from laboratory research to commercial deployment: Real world experiences in technology transfer and commercialization"*	**Panel Discussion** *Moderators: Drs. Jeff Whalen & Ajeet Kausik* Chief Guest: *Prof. Brad Theissen*
	Dr. Mike Sabo	*Chief Program Officer UN&UP*
	Mr. Eric Graban	*Founder & CEO Quarry Bio*
	Mr. Rob Britts	*Co-Founder Skyway*
	Dr. Jaspreet Dhau	*President, Research, Molekule, Inc*
	Dr. Chandra Dixit	*VP Research, Def EYE, Inc*
	Q & A	
7:30 - 8:30 PM	**Evening Reception at Florida Poly (BARC Commons)**	

Saturday, October 3	
8:30 – 9:00 AM	**Registration: BARC Main Entrance** **Breakfast: BARC Commons** **Poster: BARC 2nd Floor**
9:00 – 9:30 AM	**Conference Inauguration**
9:00 – 9:10 AM	*Opening Remarks* - **Dr. Shyam Mohapatra,** President of FAN*, Univ. of South FL*
9:10 – 9:30 AM	Welcome Remarks - **Dr. Devin Stepenson**, President, FL Polytechnique University
9:30 - Noon	**Session 3: New Frontiers in Nanomedicine** *Location: BARC #1142* *Moderators: Drs. Subhra Mohapatra & Sylvia Daunert*
9:30 – 9:50 AM	**Dr. Shanta Dhar,** *University of Miami, Miami* *"Nanotechnology Leveraging Mitochondrial Biology"*
9:50-10:10 AM	**Dr. Dipanjan Pan,** *The Pennsylvania State University, Pennsylvania* *"Context Responsive Nanoparticles for Oxygen Delivery in Resuscitation: from Concept to Translation"*
10:10- 10:30 AM	**Dr. Murali Yallapu,** *The University of Texas Rio Grande Valley, Texas* *"Polyphenol as a versatile Molecule for Nanoformulations in Cancer Treatment"*
10:30 -10:50 AM	**Dr. Mustafa Culha,** *Augusta University, Atlanta* *"Hexagonal Boron Nitrides in Nanomedicine and Nanophotonics"*
10:50-11:10 AM	**Dr. Liebe Wang,** *CEO, RWD Lifesciences Inc, Sugarland, Texas* *"Integrated Pre-clinical Solutions for Cancer Research*
11:10 -11:20 AM	**Dr. Ryan Green,** *University of South Florida, Tampa* *"A novel Nanotherapy Against Drug Resistant Brain Tumors"*
11:20 - 11:30 AM	**Dr. Stephanie Makhlouf**, *McGill University, Canada* *"Design and Optimization of Nanoparticles for MicroRNA-Mediated Stem Cell Engineering in Cardiac Repair"*
11:30 - 11:40 AM	**Dr. Mercedes Lozano-Garcia**, *University of Miami, Miami* *"Bio-inspired biopolymeric implantable platform for localized and sustained drug delivery in solid tumor treatment"*
11:40 – 11:50 AM	**Dr. Shreyasi Majumdar**, *University of South Florida, Tampa* *"Dendrimer shRNA Targeting CCL20–CCR6 Reduces Microglial Synaptic Pruning and Neuroinflammation After Repetitive Brain Injury"*
11:50 - Noon	**Q & A**

9:30-Noon	**Parallel Session 4: Nanomaterials & Nanodevices** *Location: BARC #1123*
	Moderators: Drs. Sapna Deo & Ateet Dutt
9:30 - 9:50 AM	**Dr. Swaminathan Rajaraman,** *University of Central Florida, Orlando* *"Micro/Nanosystems for Organs on a Chip, Diagnostics, and Therapeutic Applications"*
9:50 – 10:10 AM	**Dr. Antonio Ruotolo, Professor,** *College of Charleston, South Carolina* *"2D-silicon heterojunctions for infrared sensing"*
10:10 – 10:30 AM	**Dr. Azhar Ali, Assistant Professor,** *Virginia Tech, Virginia* *"Printing the Future of Biosensing: From Nano-Biointerfaces to Integrated Health"*
10:30 – 10:50 AM	**Dr. Arash Takshi, Professor,** *University of South Florida, Tampa* **"***VOC Selectivity Trend in Metalated and Non-metalated Phthalocyanines"*
10:50 – 11:10 AM	**Dr. Dmitri Voronine**, *University of Central Florida, Orlando* *"Novel Techniques for Nanoscale Cancer Imaging"*
11:10 – 11:20 AM	**Dr. Dilek Çökeliler Serdaroğlu,** *Baskent University, Turkey* *"Customizable and Modular Plasma-Beam Discharge Platform for Targeted Bio-Applications: From In-Situ Nanoparticle Fabrication to Direct Tissue Vaporization"*
11:20 – 11:30 AM	**Dr. Hyeyoung Cho**, *Florida Polytechnic University* *"Nanoconfinement-Induced Vapor Pressure Suppression of Hydrocarbons Revealed by Differential Scanning Calorimetry"*
11:30 -11:40 AM	**Dr. Nathan J. Dawson,** *Florida Polytechnic University* *"Biological Nanophotonic Structures as Laser Resonators"*
11:40 – 11:50 AM	**Dr. Tahniat Afsari**, *Molecular Medicine, University of South Florida, Tampa* *"The New Generation of Micronanorobots for Biomedical Applications"*
11:50 - Noon	**Q & A**
Noon – 12:10 PM	**PHOTO SESSION**
12:10 – 12:45 PM	**Lunch: BARC Commons**
12:45 – 2:00 PM	**NANOINNOVATION PITCH COMPETION FINAL ROUND**
2:00 – 2:15 PM	**Break**
2:15 – 4:05 PM	**Session 5: Nanotechnology Applications** *Location: BARC #1142*
	Moderators: Drs. Nathan Dawson & Nathaniel Hermann
2:15 – 2:35 PM	**Dr. Jaspreet Dhau, Vice President of R&D,** *Molekule Group Inc., Tampa* *"Sustainable Class B Fire Suppression Using Ionic Liquid-Based Fluorine-Free Firefighting Foam"*
2:35 – 2:55 PM	**Dr. Jin He, Professor,** *Florida International University* *"Probing Molecular Interactions by a Glass Nanopipette"*
2:55 – 3:15 PM	**Dr. Ateet Dutt, Professor,** *National Autonomous University of Mexico* *"Nanowires for Health: Science and Applications"*

3:15 – 3:35 PM	**Dr. Bradford A. Barker** FPU; *"Magnetic Anisotropy Energy Functions for All point Groups to Sixth Order"*
3:35 – 3:55 PM	**Dr. Matthew Smyle,** *Hofstra University* ***"****The importance of nanoscale defects in both applied and fundamental superconductivity research"*
3:55 – 4:05 PM	**Dr. Sudip Majumder**, Physics University of South Florida, Tampa *"Temperature-Dependent Spin Pumping in FeCoGd/Pt Bilayers"*
2:15 – 3:55 PM	**Parallel Session 6: Nanotechnology Applications** *Location: BARC #1123* *Moderator: Drs. Rishikesh RS Govindrajan & Dipanjan Pan*
2:15 - 2:35 PM	**Dr. Beni Dangi,** *Florida A&M University* *"Understanding Hydrocarbon Growth on Refractory Surfaces: Combined Experimental and DFT Studies"*
2:35 – 2:55 PM	**Dr. Emadelden Fouad,** *Florida Polytechnic University* *"Transfer-Matrix Design of a Ternary Photonic Crystal Nanocavity for Skin-Cancer Refractive-Index Discrimination"*
2:55 – 3:15 PM	**Dr. Atiya Banerjee,** *University of Central Florida* *"Computational Design of Nano-Agrochemicals: Insights into Interfacial Binding, Complexation and Assembly"*
3:15 – 3:25 PM	**Dr. Joseph-Ramon Codina**, *University of Miami* *"Screening Clamp Peptides Against Viruses"*
3:25 – 3:35 PM	**Dr. Aakash Nathani,** *Florida A&M* *"Multiplex cytokine and NK-associated secretome profiling demonstrates immune reprogramming by miR34a loaded lyophilized NK exosomes in lung cancer"*
3:35 – 3:45 PM	**Dr. Nathaniel G. Hermann**, *Florida Polytechnic University* *"Modeling Transport Phenomena for Dosing Control in Organ-on-a-Chip Devices"*
	Dr. Ahmed Abosalha, *McGill Univ, Canada* *"Nanoparticles-Mediated Anti-miRNA 21 Delivery: A Next-Generation Approach to Colorectal Cancer Therapy" (Virtual only)*
3:55 - 4:05 PM	**Dr. Subhash C. Chauhan, Director,** *The University of Texas Rio Grande Valley -* *"Targeted Therapies for Pancreatic Cancer" (Virtual Only)*
4:30 – 6:30 PM	**Poster Sessions** *Location: BARC #Second Floor*
6:00 - 7:00 PM	FAN Meeting

Sunday, October 4

8:30 – 8:45 AM	**Registration: BARC Main Entrance** **Breakfast: BARC Commons**
9:00–11:00 AM	**Session 7: Semiconductors Education & Research** *Location: BARC #1142*
	Moderators: Drs. Swadeshmukul Santra & Swaminathan Rajaraman
9:00 – 9:20 AM	**Dr. Ashok Kumar, Professor,** *University of South Florida, Tampa* *"Interdisciplinary Convergent Research and Education for Semiconductor Workforce Development"*
9:20 – 9:40 AM	**Dr. Sandeep Mittan, Director & Vice President,** *Amity University* *"AI-Enabled Biosensing and Biochip Technologies for Intelligent"*
9:40 – 10:00 AM	**Dr. Mohammadreza Shokouhimehr,** *Florida Polytechnic University* *"Magnetically retrievable nanocomposites for environmental remediation and rare-earth element recovery"*
10:00 – 11:00 AM	**LIGHTENING ROUND: Ten 3-minute Presentations**
9:00 – 11:00 AM	**Parallel Session 8: Semiconductors & Sensing Applications** *Location: BARC #1123*
	Moderators: Drs. Emadelden Fouad & Arash Takshi
9:00 – 9:20 AM	**Dr. Mubarak A Mujawar,** *Embry-Riddle Aeronautical University, Daytona Beach, Florida* *"Atmospheric Plasma-Assisted Synthesis of Gold Nanoparticles for SERS Applications"*
9:20 – 9:40 AM	**Dr. Rishikesh RS Govindrajan,** *Florida Polytechnic University* *"Multimodal Flexible Sensing of Strain and Temperature for wearable applications"*
9:40 – 10:00 AM	**Dr. Paria Gharavi,** *Materials Science and Engineering, University of Central Florida* *"Advanced Transmission Electron Microscopy for Nanoscale Characterization of Semiconductor Materials and Interfaces"*
10:00 – 11:00 AM	**LIGHTENING ROUND: Ten 3-minute Presentations**
11:00 - Noon	**Wrap up and Closing Remarks** *Moderators: Dr. Ajeet Kaushik & Dr. Subhra Mohapatra* *Location: BARC Commons*

Global Academy of Nanotechnology

The Global Academy of Nanotechnology (GAN) is dedicated to promoting the development and application of nanotechnology across various platforms. GAN will facilitate collaboration among researchers, educators, and industry leaders to drive innovation and address global challenges. The association will provide resources, training, and networking opportunities to its members, fostering a community committed to the responsible and ethical advancement of nanotechnology. Through conferences, publications, and outreach programs, GAN aims to raise awareness about the potential of nanotechnology and its impact on society, ensuring that its benefits are accessible to all.

GAN's mission is to advance the field of nanotechnology through global research, education, and innovation, while fostering global partnerships and promoting the responsible development and application of nanotechnologies for the benefit of society.

NanoFlorida International Conference will feature the 2026 class of inductees to the GAN Fellowship, signifying their exemplary work and impact on nanoscience and nanotechnology and its translation toward societal benefits.

We are excited to recognize and support the brightest minds in nanotechnology through the GAN Fellowship for years to come.

Session 1 Moderators

Shyam Mohapatra
President of FAN
University of South Florida



Dr. Shyam S. Mohapatra is a nationally and internationally recognized leader in nanomedicine, translational bioengineering, and biomedical innovation, with a distinguished academic career at the University of South Florida spanning nearly three decades. His pioneering work in nanoscale biomedical diagnostics and therapeutics has advanced new approaches for the detection and treatment of cancer, asthma, viral infections, and traumatic brain injury. He is the founding president of the Florida Association for Nanobiotechnology, a statewide non-profit organization with more than 700 members spanning academic institutions, industry, and research organizations engaged in nanobiotechnology across Florida.

Larry Hall
Professor & Assoc Dean of Research
University of South Florida



Lawrence Hall is a Distinguished University Professor and Associate Dean of Research Innovation Bellini College of Artificial Intelligence, Cybersecurity and Computing of University of South Florida in Tampa, FL. He received his PhD in Computer Science from the Florida State University in 1986 and a Bachelor of Science in Applied Mathematics from the Florida Institute of Technology in 1980. He has authored or co-authored more than 300 publications in journals, as well as many conference papers and book chapters. His early work showed that unsupervised fuzzy clustering could be combined with a knowledge-based approach to segment brain tumors in an explainable manner.

Pre-2026 NIC Symposium on AI and Health Technologies: Promises and Perils | 1:00 - 4:30pm EST

Moderated by: Dr. Shyam Mohapatra & Dr. Larry Hall

Mark Mosley
Chairman
University of South Florida



Dr. Mark G. Moseley joined USF Health in January 2017 as USF Health's Chief Medical Officer and Associate Dean for Clinical Affairs in the USF Health Morsani College of Medicine (MCOM). Since April 2022, he has served as the first President of USF Tampa General Physicians, a role he was selected for via competitive national search. As President, he leads the integration of the Tampa General Hospital and USF physician practice infrastructure; leading ~1,500 team members and supporting the practices of nearly 1,000 clinicians. Dr. Moseley is a Professor in the MCOM Department of Internal Medicine, Division of Emergency Medicine, and is a member of the Medical Staff at Tampa General Hospital.

Moez Limayem
President
University of South Florida



Moez Limayem took office as the ninth president of the University of South Florida in February 2026 following his unanimous selection by the USF Board of Trustees and confirmation by the Florida Board of Governors. Limayem is a higher education leader with more than 35 years of experience advancing student success, research impact, fundraising and community and industry partnerships. With an energetic, passionate and collaborative style, he is a strategic leader with a record of achievements in student and faculty success, development and industry-education partnerships. Throughout his career, he has emphasized the role of universities as engines of opportunity, innovation and economic impact. Limayem is a globally recognized scholar in information systems, and his research has been cited more than 16,000 times in prestigious academic journals, including MIS Quarterly, Information Systems Research, Management Science and the Journal of Management Information Systems.

Robert Langer
Professor
Massachusetts Institute of Technology



Robert Langer is one of 9 Institute Professors at MIT; being an Institute Professor is MIT's highest honor. His articles have been cited over 481,000 times; his h-index of 338 is the highest of any engineer in history. His patents have licensed or sublicensed to over 400 companies; he is a cofounder of many companies including Moderna. He holds 46 honorary doctorates and has received over 220 awards, including both the United States National Medals of Science and Technology & Innovation (one of 3 living individuals to have received both honors), and has been elected to the National Academies of Medicine, Engineering, Sciences, and Inventors.

From nanotechnology to mRNA vaccines: How overcoming skepticism and barriers led to new cancer treatments and ways to tackle a global health challenge

Langer will reflect on five decades of progress, beginning with the widespread scientific skepticism of the 1970s surrounding macromolecule delivery, and charting the field's growth into a robust therapeutic platform with an expanding portfolio of approved treatments and a promising pipeline of candidates in development.

Larry Hall
Professor & Assoc Dean of Research
University of South Florida



Lawrence Hall is a Distinguished University Professor and Associate Dean of Research Innovation Bellini College of Artificial Intelligence, Cybersecurity and Computing of University of South Florida in Tampa, FL. He received his PhD in Computer Science from the Florida State University in 1986 and a Bachelor of Science in Applied Mathematics from the Florida Institute of Technology in 1980. He has authored or co-authored more than 300 publications in journals, as well as many conference papers and book chapters. His early work showed that unsupervised fuzzy clustering could be combined with a knowledge-based approach to segment brain tumors in an explainable manner.

AI & Health: Promises and Perils

Artificial Intelligence (AI) has a lot of possible uses in the health field. AI is being used to transcribe discussion between patients and medical providers. There has long been work on using AI in mammography as a second reader and there are many papers discussing the use of AI in medical imaging for X-ray, CT, MRI, etc. evaluation. Google has developed Diabetic Retinopathy Detection using AI (typically with a human in the loop because camera changes and other factors require monitoring). Further AI large language models can now provide reviews of a field or suggest problems to work on or approaches to problems in the health field. However, AI can (perhaps occasionally) provide incorrect answers to questions and provide references that do not exist. This talk will cover how AI may help with health problems using an example in nano biotechnology and what perils yet exist. I will posit it can be a time saver but requires diligent oversight.

Yang Yang
Professor
University of South Florida



Dr. Yang Yang is a full professor at the Nanoscience Technology Center, Department of Materials Science and Engineering, University of Central Florida (UCF). He received his Ph.D. from Tsinghua University, followed by prestigious Alexander von Humboldt and Peter M. & Ruth L. Nicholas Postdoctoral Fellowships at Erlangen-Nuremberg University and Rice University. Since 2015, he has served as a Principal Investigator at UCF, leading research at the intersection of nanoscale materials chemistry, interface engineering, and electrochemistry. His work drives advances in energy generation, storage, electrification, and chemical conversion. A pioneer in sustainable catalysis and functional materials, Prof. Yang has authored over 170 peer-reviewed articles, including high-impact publications in Nature Energy, Nature Communications, and Chemical Reviews.

Nano-carbon technology for advanced biofuel and chemical conversion

The future of sustainable energy and chemicals is distributed: fuels and chemical feedstocks produced where they are needed, from renewable inputs, without centralized fossil-intensive plants. Two technologies exemplify this shift: direct ethanol fuel cells, which convert a renewable biofuel directly into quiet, cold-start power, and electrochemical hydrogen peroxide synthesis, which promises on-site production of a green oxidant without the energy-intensive anthraquinone process. Both have been held back by the same fundamental challenge: controlling catalytic interfaces at the atomic scale. This talk presents a unified materials strategy based on engineered nano-carbon interfaces, tuning local coordination, defects, and metal-support interactions, that advances both fronts. On the energy side, interface-designed catalysts unlock efficient, durable ethanol-to-electricity conversion, sustaining device-level power densities over a thousand hours of operation. On the chemicals side, metal-free doped-carbon catalysts enable selective, long-lived H 2 O 2 electrosynthesis, and pairing peroxide production with value-added anode chemistry multiplies process economics by more than an order of magnitude. Together, these results illustrate a broader principle: atomic-scale interface design is a transferable platform for decarbonizing both energy conversion and chemical manufacturing.

Anworul Kabir
Assistant Professor
University of South Florida



Anowarul Kabir is an assistant professor at the USF Bellini College of Artificial Intelligence, Cybersecurity and Computing. He contributes to teaching in AI, machine learning, and data mining while continuing his research on knowledge-guided deep learning methods. Kabir is the founder of the Kabir's AI for Bio Lab at USF. Prior to joining the college in 2025, Kabir worked in the Shehu AI Lab at George Mason University as well as the Los Alamos National Lab in New Mexico. Before his academic research career, Kabir worked in software development, including roles at Samsung R&D Institute Bangladesh and Streams Tech Inc.

Survival-aware Representation Learning from Omics for Cancer Prognosis

High-dimensional omics data are vital for forecasting patient prognosis in oncology. While deep multi-omics learning methods are increasingly popular, they suffer from data missingness and low patient overlap across modalities. Consequently, advancing single-omic representation learning remains a critical yet challenging research problem. Standard generative dimensionality reduction methods rely on reconstruction objectives that optimize the global manifold topology; however, overlook downstream clinical outcomes. To address these limitations, we introduce a Contrastive Masked Denoising Variational Autoencoder (CMVAE), a self-supervised dual-optimization framework designed to map single-omic information into a clinical outcome-aware latent space. A stochastic feature masking strategy corrupts the input omic profiles, and CMVAE is optimized to simultaneously infer missing molecular data and contrastive alignment of patient survival trajectories. We evaluate CMVAE using leak-proof five-fold stratified cross-validation on the TCGA Breast Invasive Carcinoma (BRCA) cohort. The method outperforms traditional unsupervised methods, achieving an AUROC of 0.7397 ± 0.0239 on patient prognosis. Further analysis demonstrates a highly significant ($p < 0.0001$) risk stratification among low- vs. high-risk groups.

Industry Panel Moderators

Jeffrey Whalen
CEO
Magnetics Corporation



Mr. Sabo is an expert in the design of benchtop, in vitro, and in vivo experimental models. He has worked with magnetism-based medical technologies for over 25 years. Companies include Stereotaxis (magnetic microparticles and electrophysiology catheters), Pulse Therapeutics (magnetic nanoparticles for the treatment of stroke), Cardialen (implantable cardioversion), and UN&UP (magnetic technologies accelerator). He has been involved in taking multiple medical devices from the R&D stage of development through approval by the FDA. Prior to shifting into the world of medical device startups, Mr. Sabo worked for seven years with the National High Magnetic Field Laboratory – DC Field Operations Group. He joined the MagLab during

Ajeet Kaushik
Associate Professor
Florida Polytechnic University



Eric Graban is the Founder and CEO of QuarryBio, a Tallahassee-based life sciences company that he started in 2011. Through funding from angel investors, SBIR grants from the NIH, and client revenue, they developed a novel mass spectrometry based tool to help biotech companies during drug development and served clients ranging from fortune 500 companies to small start-ups based in the US, EU, and APAC. QuarryBio has since gone through several iterations and is currently pursuing several research and business opportunities, with funding coming primarily from various contract research projects. Prior to founding QuarryBio, Eric worked in various capacities as a

Industry Panel Moderators

Brad Thiessen, Ph.D., PStat®
Provost and Vice President for Academic Affairs
Florida Polytechnic University



As Provost and Vice President of Academic Affairs, Dr. Brad Thiessen oversees all aspects of the university's ongoing operations with curriculum and instruction, faculty recruitment and development, institutional effectiveness, registration and academic records, academic resources, research programs, and university institutes.

Crossing the chasm from laboratory research to commercial deployment: Real world experiences in technology transfer and commercialization | 6:00 - 7:30pm EST

Mike Sabo
Chief Program Officer
UN&UP



Mr. Sabo is an expert in the design of benchtop, in vitro, and in vivo experimental models. He has worked with magnetism-based medical technologies for over 25 years. Companies include Stereotaxis (magnetic microparticles and electrophysiology catheters), Pulse Therapeutics (magnetic nanoparticles for the treatment of stroke), Cardialen (implantable cardioversion), and UN&UP (magnetic technologies accelerator). He has been involved in taking multiple medical devices from the R&D stage of development through approval by the FDA. Prior to shifting into the world of medical device startups, Mr. Sabo worked for seven years with the National High Magnetic Field Laboratory – DC Field Operations Group. He joined the MagLab during Phase 3 construction and remained through commissioning and the first three years of operation.

Eric Graban
Founder & CEO
Quarry Bio



Eric Graban is the Founder and CEO of QuarryBio, a Tallahassee-based life sciences company that he started in 2011. Through funding from angel investors, SBIR grants from the NIH, and client revenue, they developed a novel mass spectrometry based tool to help biotech companies during drug development and served clients ranging from fortune 500 companies to small start-ups based in the US, EU, and APAC. QuarryBio has since gone through several iterations and is currently pursuing several research and business opportunities, with funding coming primarily from various contract research projects. Prior to founding QuarryBio, Eric worked in various capacities as a scientist and in management for Eli Lily and Baxter. He holds a bachelor's degree in Biology from Brown University and an MS in physical organic chemistry from Ohio University.

Jaspreet Dhau
President
Molekule, Inc



Dr. Jaspreet Dhau is the Vice President of Research and Development at Molekule, bringing more than 20 years of extensive research experience in both academia and private industry. Dr. Dhau has successfully commercialized eight technologies and spearheaded over 20 research and product development initiatives, including projects funded by the US Department of Defense. His work has earned him multiple accolades, including the Pran Nath Vohra Research and Entrepreneurship Award and the Distinguished Alumnus Award from Panjab University. In 2022, he was recognized by the National Academy of Inventors as one of the world's top emerging inventors. Dr. Dhau's research specialties encompass indoor air purification, photocatalysis, fluorine-free firefighting foams, coatings and coating removal technologies. Dr. Dhau has secured 25 granted patents, and his scholarly contributions include over 65 peer-reviewed research articles published in leading scientific journals.

Rob Britts
Co-Founder & CEO
Skyway



Rob Britts is the Co-Founder and CEO of Skyway. Skyway is a quantum-enabled materials manufacturer and digital AI engineering company developing integrated materials and intelligent systems for the aerospace, defense, maritime, energy, and advanced industrial markets.

Chandra Dixit
VP Research
Def EYE, Inc



Chandra Dixit is a scientific leader with 15+ years' industry experience within IVD, Bioanalytical, and RUO space. He is currently focused on developing products & services pipeline, and product portfolio while delivering multiplex biomarker detection methods at faster turnarounds. Chandra Dixit manages cross-functional teams in regulated GxP environments & external collaborations, and solving complex challenges. He provides leadership in innovation and product development efforts, delivering cutting-edge immuno- and molecular-based solutions, including antibody development, immunoassays, and bioassays ensuring product excellence from concept through to launch, while strictly adhering to quality and regulatory standards.

Conference Inauguration | 9:00 - 9:30am EST

Shyam Mohapatra
President of FAN
University of South Florida



Dr. Shyam S. Mohapatra is a nationally and internationally recognized leader in nanomedicine, translational bioengineering, and biomedical innovation, with a distinguished academic career at the University of South Florida spanning nearly three decades. Dr. Mohapatra's research program has attracted over $45 million in extramural funding, resulting in more than 250 peer-reviewed publications and over 40 U.S. and international patents. His pioneering work in nanoscale biomedical diagnostics and therapeutics has advanced new approaches for the detection and treatment of cancer, asthma, viral infections, and traumatic brain injury. He is the founding president of the Florida Association for Nanobiotechnology, a statewide non-profit organization with more than 700 members spanning academic institutions, industry, and research organizations engaged in nanobiotechnology across Florida.

Devin Stepenson
President
Florida Polytechnic University



As its second president, Dr. Devin Stephenson is responsible for continuing Florida Poly's tradition of excellence and overseeing the University's continued growth. He is committed to expanding the University's state and national reputation as an innovative leader in higher education and graduating Florida's top engineers. Throughout his distinguished career, Stephenson has utilized his expertise in leading the design and implementation of academic programs and providing comprehensive administrative and operational leadership to achieve organizational missions. In 2022, Stephenson was appointed by Florida Governor Ron DeSantis as a member of the Executive Council of the Southern Regional Education Board, a board established to improve education by providing policymakers with reliable data to inform sound policies, collaborating with states to share resources, and serving educators by providing the training they need to help prepare students for their futures. Driven by a duty to elevate higher education, his community, and his state, Stephenson is continuously involved in professional, academic, community, civic, and other important organizations and associations.

Parallel Sessions 3 and 4 Moderators

Subhra Mohapatra
Professor
University of South Florida



Dr. Subhra Mohapatra is an internationally recognized translational scientist, inventor, educator, and leader in nanomedicine, targeted drug delivery, neuroinflammation, neurodegenerative diseases, and cancer therapeutics. Dr. Mohapatra has authored more than 118 publications, secured sustained NIH, VA, and industry funding, and developed numerous technologies advancing precision medicine and therapeutic delivery. An accomplished inventor, Dr. Mohapatra holds 35+ U.S. and international patents spanning cancer therapeutics, neurodegenerative diseases, nanomedicine, gene delivery, personalized medicine, diagnostic technologies, and antiviral therapies.

Sylvia Daunert
Professor
University of Miami



Sylvia Daunert, PharmD, MS, PhD, is the Lucille P. Markey Chair of Biochemistry and Molecular Biology at the Miller School of Medicine and the Director of the JT Macdonald Foundation Biomedical Nanotechnology Institute, and Director of hte Frost Institutes and University STEM Centers and Institutes of the University of Miami. Dr. Daunert's research focuses on the development of bio-inspired nanotechnologies to solve biomedical and environmental problems. Dr. Daunert's research focuses on the development of bio-inspired nanotechnologies to solve biomedical and environmental problems.

Parallel Sessions 3 and 4 Moderators

Sapna Deo
Professor
University of Miami



Dr. Sapna Deo is the program director at the MS Graduate Program of Biochemistry and Molecular Biology at the University of Miami. She is an author and co-author of over 70 scientific publications and several patents and a recipient of the NSF-CAREER Award. Dr. Deo's research interest is in the development of technologies for the detection of pathogens for resource poor settings. Her work also involves design of novel nanobioanalytical techniques based on luminescence and quantum dots for detection of microRNAs and RNA molecules for application in biomedicine, diagnosis, and pathogen detection.

Ateet Dutt
Professor
Universidad Nacional Autónoma de México



Dr. Ateet Dutt earned a Master's in Nanotechnology from VIT University in India in 2011. Subsequently, he earned his Ph.D. in Electrical Engineering (Solid-State Electronics) from CINVESTAV, Mexico City (2012-2015). He also conducted two years of postdoc research at the Materials Research Institute, UNAM (2016-2018). He has published several articles in international peer-reviewed journals and one edited book on Nanosensors. He is awarded as a member of the National Researchers System (Mexico) (level II), awarded by the National Council of Science and Technology of Mexico (SECIHTI).

Parallel Session 3: New Frontiers in Nanomedicine

9:30am - 12:00pm EST

Shanta Dhar
Professor
University of Miami



Shanta Dhar is a Full Professor of Biochemistry and Molecular Biology at the University of Miami Miller School of Medicine and co-leads the Engineering Cancer Cures program at Sylvester Comprehensive Cancer Center. Her lab pioneered mitochondria targeted nanomedicine, developing metal and nanoparticle-based therapeutics for cancer. Trained at the Indian Institute of Science, Bangalore, she completed postdoctoral work with Marc Greenberg at Johns Hopkins and Stephen J. Lippard at MIT as an Anna Fuller Fellow. She joined the University of Miami in 2016 after serving as Assistant Professor at the University of Georgia. Dr. Dhar's work has produced a robust translational pipeline of nanotherapeutics. She is a Fellow of the Royal Society of Chemistry and an elected Fellow of the National Academy of Inventors.

Nanotechnology Leveraging Mitochondrial Biology

The Dhar lab specializes in developing metal and nanotechnology-based therapeutics for mitochondrial nanomedicine. In this presentation, I will discuss how mitochondrial biology and variations in key functional parameters in the diseased stage can be leveraged to engineer targeted nanoparticles that access mitochondrial network for potential therapeutic benefits across hard-to-treat diseases. I will also demonstrate how this targeting strategy enables selective penetration of impermeable barriers, such as the blood brain barrier, while preserving others like the placental barrier, thereby unlocking access to central nervous system disorders ranging from neurodegeneration to glioblastoma. Finally, I will discuss integration of therapeutic loaded nanomaterials with standard treatments like surgery, augmented by lifestyle interventions such as dietary modifications, to prevent or delay glioblastoma recurrence.

Dipanjan Pan
Dorothy Foehr Huck & J. Lloyd Huck Chair Professor
The Pennsylvania State University



Prof. Pan is an internationally renowned expert in nanomedicine. He is presently a Dorothy Foehr Huck & J. Lloyd Huck Chair Professor in Nanomedicine, and tenured Full Professor in the Pennsylvania State University. His research is highly collaborative and interdisciplinary, centering around the development of novel materials for biomedical applications, molecular imaging, controlled drug delivery, and biosensing approaches. Over the years, this research has resulted in >200 high impact peer reviewed publications in scientific journals, many patents, and several technology licensing. Prof. Pan is currently funded by five NIH awards, NSF, CDC, DoD/CDMRP, DARPA and 2 ARPA-H along with industry funding. He is the founder/co-founder of five University based early start-ups, including Vitruvian Bio, dedicated to developing HIV-1 diagnostics; InnSight Technologies dedicated for ocular diseases and KaloCyte, Inc, to develop artificial oxygen career for human trauma. Prof. Pan is an Associate Editor for ACS Nano Medicine.

Context Responsive Nanoparticles for Oxygen Delivery in Resuscitation: from Concept to Translation

Blood substitutes remain an elusive Holy Grail. Developing such a product will, however, revolutionize surgical and critical care medicine. It is critically important for life-threatening blood loss to be treated with a transportable, temperature-stable blood substitute, containing an artificial oxygen carrier (O2), in pre-hospital, austere military and other resource-limited settings where stored blood products are frequently unavailable, undesirable, or in short supply. To fill this need, we have developed ErythroMer (EM), a bio-synthetic, nanocyte blood substitute that is first in class. The EM nanoparticle is a deformable, hybrid peptide-lipid nanoparticle incorporating hemoglobin (Hb) in a manner that simultaneously inhibits the release of nitric oxide (NO) and controls O2 capture and release in a context-responsive manner. By using EM 'artificial cells' as a model, we've been able to create a prototype that fully mimics key RBC physiology and presents a potentially disruptive innovation for transfusion medicine. This design overcomes all prior challenges to emulating normal RBC physiologic interactions with O2 and NO through rigorous initial proof-of-concept testing (in vitro and in vivo). EM can restore normal hemodynamics and oxygen delivery in preclinical models of major bleeding or anemia at the system, tissue, and cellular levels. There are significant implications for portability and use of EM's potential for extended ambient dry storage. We will discuss how the effective programming of EM physiologic ‘’wetware’ is achieved by manipulating the physico-chemical properties of the shell and payload components, their physico-chemical properties, and extensive biological attributes in small and large animal models (e.g., rabbit and non-human primate). The introduction of a successful blood substitute with easy portability and administration in the field may fundamentally change the world of Resuscitation and Transfusion Medicine.

Murali Yallapu
Professor
The University of Texas Rio Grande Valley



Murali M. Yallapu, PhD, is a tenured Professor in the Division of Cancer and Immunology at the School of Medicine, UTRGV, McAllen, Texas, USA. Dr. Yallapu is Director of Drug Delivery and Nanomedicine (DDNC) and Research Capacity Core (RCC). He is also a Member and Program Coordinator of the South Texas Center of Excellence in Cancer Research.He has authored more than 205 peer-reviewed research articles and reviews, numerous book chapters, and over 180 conference abstracts. His scholarly work has been cited over 20,641 times, with an h-index of 73 and an i10-index of 185. His current research focuses on the design and development of functional nanomaterials to enhance the therapeutic efficacy of clinically relevant drugs and to create novel nanoconstructs for biomedical applications.

Polyphenol as a versatile Molecule for Nanoformulations in Cancer Treatment

A naturally occurring polyphenol, Tannic acid (TA), has emerged as a multifunctional molecule with significant potential in cancer therapy and nanomedicine. Studies have demonstrated that TA inhibits cancer cell proliferation, migration, invasion, and clonogenicity while promoting apoptosis through multiple events. TA exhibits potent anticancer effects by modulating multiple cellular pathways involved in tumor growth and progression. Furthermore, TA suppresses lipid metabolism and oncogenic signaling pathways that are critical for cancer cell survival, particularly in prostate cancer. Beyond its therapeutic activity, TA serves as a versatile nanoplatform component for the delivery of anticancer agents. TA-based nanoformulations, including paclitaxel nanoparticles, docetaxel self-assemblies, modified pectin nanocomplexes, and inhalable metal-phenolic nanoparticles, have demonstrated improved drug encapsulation, enhanced cellular uptake, targeted tumor accumulation, reduced drug resistance, reversal of cellular senescence, and superior anticancer efficacy across various cancer cell line and mouse models. Notably, inhaling TA nanocarriers also exhibited antimicrobial activity, highlighting their multifunctional therapeutic potential. Collectively, the unique biochemical and formulation properties of TA position is as a promising theranostic and drug-delivery platform for next-generation cancer nanomedicines.

Mustafa Culha
Professor
Augusta University



Dr. Mustafa Culha is a professor at the Department of Chemistry and Biochemistry of Augusta University (GA, USA) with a distinguished career spanning both academia and industry.His interdisciplinary research integrates chemistry, medicine, materials science, photonics, and nanotechnology, with a focus on analytical and bioanalytical chemistry and nanobiotechnology. He has authored over 135 peer-reviewed publications, in addition to numerous book chapters and patents. His work is widely recognized for advancing nanoscale spectroscopy and its biomedical applications. Dr. Culha served as President of the Federation of Asian Chemical Societies (FACS) for the 2023–2025 term, reflecting his leadership in the global scientific community.

Surface-Enhanced Raman Scattering for Early Cancer Detection through Liquid Biopsy

Early cancer detection is critical for improving treatment outcomes and patient survival, yet many current diagnostic approaches remain limited by insufficient sensitivity, invasiveness, or high cost. Liquid biopsy offers a minimally invasive strategy for detecting disease-associated molecular changes in blood and other body fluids. Among emerging analytical methods, surface-enhanced Raman scattering (SERS) is particularly promising because it enables rapid, highly sensitive, and label-free molecular fingerprinting of complex biological samples with minimal sample preparation. This presentation will examine the potential of SERS-based liquid biopsy for early cancer detection, with particular emphasis on serum- and plasma-based analyses using noble metal nanoparticles. When biological fluids interact with gold or silver nanoparticles, proteins, lipids, metabolites, and other biomolecules adsorb onto the nanoparticle surface and form a biomolecular corona. The resulting SERS spectrum therefore reflects not only tumor-derived biomarkers, but also systemic physiological changes, nanoparticle properties, competitive adsorption, sample preparation, drying behavior, and instrumental acquisition conditions. Recent advances in nanoparticle design, spectral preprocessing, multivariate analysis, and machine learning have improved the ability of SERS platforms to distinguish cancer patients from healthy controls. However, major challenges remain, including limited molecular interpretation, small and heterogeneous patient cohorts, inadequate external validation, and insufficient standardization of experimental parameters. A more mechanistically informed approach is required to separate true biological signals from experimental artifacts and nonspecific disease effects. By improving reproducibility, standardizing workflows, and validating performance in large multicenter studies, SERS-based liquid biopsy may become a valuable tool for early cancer screening, disease monitoring, and personalized clinical decision-making.

Nanoparticles Delivery: From Precision Isolation to In Vivo Tracing

Liebe Wang
Regional sales manager
RWD Life Science Co., Ltd.



RWD Life Science specializes in Life Science, Animal Healthcare and Clinical Laboratory. Dedicated to contributing our wisdom and effort to the improvement of the quality of life， we are also firmly committed to being the global advanced science enterprise. You will learn about a complete preclinical research solution that covers the entire process from animal model construction to in vivo imaging, providing a seamlessly integrated platform for life science research. We will explore the core imaging platform, then introduce five key modules: model preparation, surgical instruments and drug delivery, pathological section preparation, cell sorting, and cell monitoring, and finally summarize the entire workflow.

Ryan Green
Post-Doc
University of South Florida



Ryan obtained his undergraduate degree in molecular biology at Florida Atlantic University in 2010 before coming to the University of South Florida's professional science master's program. He graduated from the program in 2011 and joined Dr. Subhra Mohapatra's lab at USF. He has worked on multiple projects including biosensor development, respiratory syncytial virus studies, and his dissertation research developing novel treatments targeting cancer stem cells in a three-dimensional nanofiber culture model. Ryan was awarded with an American Heart Association fellowship, and he earned his Ph.D. in Medical Science from USF in 2018. His post-doctoral work has focused on adjunct therapies for lung cancer and glioblastoma including nano-scale drug delivery strategies. He is currently a research associate in the USF department of Molecular Medicine.

A novel Nanotherapy Against Drug Resistant Brain Tumors

Temozolomide (TMZ) is the standard of care for glioblastoma (GBM), yet median survival remains under 24-months. Evidence indicates that chemotherapies can upregulate CCL20, a chemokine linked to poor survival. We hypothesize that inhibiting CCL20, in combination with TMZ or TMZ-based regimens, will improve therapeutic outcomes. To investigate CCL20's role, we used in vitro, in vivo, and ex vivo murine GBM, patient samples and gene expression datasets. Mouse and human GBM cell lines (CT-2A, GL261, U87, and U251) were screened for viability, and CCL20 expression was assessed via qPCR and immunostaining. TCGA Patient data were analyzed to compare CCL20 expression across cohorts. Subcutaneous tumors were initiated with mouse cell lines for testing drug efficacy in vivo. Following treatment, tumors were collected for proteomic and lipidomic analyses using mass spectrometry. Organoid cultures derived from orthotopic tumors and clinical samples were used to assess drug response by confocal microscopy. The combination of TMZ + cannabidiol (CBD) demonstrated synergy in both mouse and human cell lines. CCL20 expression increased with TMZ and/or CBD+TMZ treatment. In vivo, subcutaneous CT-2A tumors responded similarly to TMZ or TMZ+CBD, each reducing tumor growth compared to vehicle. However, CCL20/CCR6 inhibition via shRNA plasmid delivered using PAMAM nano-dendriplexes significantly reduced tumor growth compared to TMZ or TMZ+CBD alone. Lipidomic analyses revealed elevated levels of resolvin precursor 17-HDHA, and proteomic profiling confirmed downregulation of CCL20 along with other growth regulators including EGF, FGF, and KLF4 in the TMZ+CBD+shCCL20 group. In contrast, tumors treated with TMZ+CBD exhibited increased CCL20 signaling and heightened inflammation. Collectively, these results suggest that targeting CCL20/CCR6 signaling enhances the efficacy of TMZ-based therapies by sensitizing GBM tumors to treatment. Therapeutic strategies that modify the inflammatory tumor microenvironment, such as CCL20 inhibition with TMZ and CBD, hold strong potential for improving GBM outcomes. This work was supported by a Veterans Affairs Merit Review grant BX005757 awarded to SM, and by Research Career Scientist Awards, IK6BX004212 to SM and IK6BX006032 to SSM. Although this report is based in part on work supported by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, the contents do not represent the views of the Department of Veterans Affairs or the United States Government.

Stephanie Makhlouf
Post-Doc
McGill University



Stephanie Makhlouf is a PhD candidate in Biomedical Engineering at McGill University with a multidisciplinary in tissue engineering, microencapsulation, and nano-therapeutic systems. Her research focuses on the design and development of polymeric drug delivery platforms for the genetic engineering of stem cells in cardiovascular applications. In addition to being awarded the Shuk-Tak fellowship in medicine, her contributions to the field have resulted in eight peer-reviewed original research and review publications. With experience from teaching Cell & Tissue engineering course at McGill University to experimental work involving micro- and nano-particle synthesis, physicochemical characterization, in vitro and in vivo inflammatory and cardiac disease modeling, her aim is to engineer controlled and targeted therapeutic platforms with clinical translational potential for precision cardiovascular medicine.

Design and Optimization of Nanoparticles for MicroRNA-Mediated Stem Cell Engineering in Cardiac Repair

The field of tissue engineering and regenerative medicine have witnessed significant advancements in recent years. Particularly, stem cell technology has shown promising therapeutic capabilities for promoting myocardial repair, enhancing of vascularization, and managing cardiovascular diseases. Despite their potential, undifferentiated stem cells face key limitations, including uncontrolled proliferation, premature senescence, and gradual loss of stemness, all of which can compromise their therapeutic effectiveness. Genetic modulation of stem cells has therefore emerged as a powerful approach to enhance their reparative potential prior to transplantation. For instance, inhibition of let 7 has been associated with enhanced stemness, increased proliferative capacity, and upregulation of pro-angiogenic pathways. However, microRNA (miRNA)-based therapeutics face major delivery challenges, as these small nucleic acids are highly prone to enzymatic degradation, rapid clearance, and poor cellular uptake. To overcome these biological and physicochemical barriers, this study presents the synthesis of a polymeric nanoparticle-based delivery platform designed to encapsulate and protect let-7 miRNA inhibitors for an efficient delivery to stem cells. The engineered nanocarriers demonstrated favorable physicochemical characteristics, including uniformly dispersed spherical nanoparticles. They showed an effective cellular internalization without causing cytotoxicity related to the nanoparticles. Additionally, functional assays of stem cells following nanoparticle-mediated let-7 inhibition resulted in enhanced proliferative activity and pro-angiogenic phenotype, with increase Ki-67 expression. This integrated nanobiotechnology and gene engineering strategy offers a promising platform for improving stem cell-based therapies and their regenerative potential on heart regeneration and repair.

Mercedes Lozano-Garcia
Post-Doc
University of Miami



Mercedes Lozano-García is a Biochemistry and Molecular Biology postdoctoral associate in the Miller School of Medicine at the University of Miami. She earned her PhD in Biochemistry and Molecular Biology from University of Miami under the guidance of Dr. Sylvia Daunert and Dr. Sapna Deo. She received both PharmD and B.S. Biotechnology degrees in Madrid (Spain), where she is originally from. Her professional interests include nanotechnology, biotechnology, and personalized medicine, among others.

Bio-inspired biopolymeric implantable platform for localized and sustained drug delivery in solid tumor treatment

Chemotherapy is a widely used modality in cancer treatment. However, the use of certain chemotherapeutic agents in the clinic is hindered by their poor solubility in aqueous excipients, chemical instability, and potent toxicity and adverse effects when systemically delivered. The delivery of chemotherapeutic drugs from an implantable system is promising as it can potentially overcome these challenges by providing localized and sustained drug release to improve efficacy in the tumor while minimizing side effects. In this study, our team developed a bio-inspired implantable drug delivery platform loaded with a model chemotherapy drug by employing a combination of 3D-printing, freeze-drying, and crosslinking techniques. The implantable platform is fabricated using 3D-printed molds and features a bio-inspired gyroid 3D-structure. Implants demonstrated tailored drug loading capabilities and a sustained drug release over a 3-month period, with up to 50% mass degradation in vitro. In vivo studies in mice revealed a significant reduction in the growth of HCT116 human colorectal xenograft tumors, without detectable side effects. These findings suggest the platform's efficacy and safety for localized and sustained delivery of chemotherapy to the tumor site. Furthermore, the versatile formulation of the implants enables the incorporation of other toxic, insoluble, or unstable drugs, offering an alternative to conventional delivery systems for treating solid tumors.

Shreyasi Majumdar
Post-Doc
University of South Florida



Dr. Shreyasi Majumdar is currently a Postdoctoral Scholar in the Department of Molecular Medicine at the University of South Florida. She is a pharmacology researcher with expertise in neuropharmacology, neuropathic pain, neuroimmune mechanisms, biomaterials, and tissue engineering. Her research experience includes in vitro, ex vivo, and in vivo models, along with behavioral tests, molecular biology, immunohistochemistry, and electrophysiology. She earned her Ph.D. and M. Pharm from the Indian Institute of Technology (Banaras Hindu University), Varanasi, India. Her research interests focus on neurodegeneration, neuroinflammation, and translational pharmacology. She has authored several peer-reviewed publications spanning neuropathic pain, neuroimmune signalling, bioactive materials, and Alzheimer's disease. She is also a recipient of the DST-INSPIRE Fellowship and her broader goal is to advance translational research at the interface of neuroscience and therapeutic development.

Dendrimer shRNA Targeting CCL20–CCR6 Reduces Microglial Synaptic Pruning and Neuroinflammation After Repetitive Brain Injury

Repeated traumatic brain injury (rTBI) is a significant neurological concern among athletes, military personnel, and individuals exposed to recurrent concussions. Unlike isolated mild injuries, repeated insults within the recovery window exacerbate pathology and drive cumulative neurodegeneration. Persistent microglial activation and maladaptive complement signaling establish a chronic inflammatory environment that accelerates synaptic degeneration and network dysfunction. Deposition of complement components (C1q, C3) marks vulnerable synapses for microglial pruning, while CCL20–CCR6 signaling sustains inflammation by recruiting immune cells and amplifying glial activation. Together, these processes contribute to long-term cognitive decline and progressive neurodegeneration following rTBI. A mouse rTBI model was used to examine the role of CCL20–CCR6 signaling in chronic neuroinflammation and synaptic injury. Poly(amidoamine) dendrimers were employed to deliver shRNA constructs targeting CCL20 and CCR6. Dual shRNA dendriplex (DPX) formulations were administered post-injury. Neuroinflammatory markers, complement deposition, and synaptic integrity were evaluated using immunohistochemistry, molecular analyses, and quantitative imaging. rTBI induced sustained upregulation of CCL20 and CCR6, accompanied by prolonged microglial activation and increased complement deposition at synapses. This inflammatory milieu promoted excessive synaptic pruning and neuronal loss. Treatment with shCCL20–CCR6 DPX significantly reduced CCL20 and CCR6 expression, attenuated microglial reactivity, and limited complement-mediated synaptic elimination. Animals receiving DPX therapy exhibited preserved synaptic density and improved neuronal integrity compared with untreated controls. These findings identify the CCL20–CCR6 axis as a key regulator of the inflammatory–complement cascade driving synaptic vulnerability after rTBI. Dendrimer-delivered shRNA therapy effectively suppressed neuroinflammation and protected synaptic architecture, underscoring a promising strategy to mitigate chronic pathology. Targeting CCL20–CCR6 may represent a novel therapeutic approach to preserve neuronal function and reduce long-term neurodegenerative consequences of repeated brain injury.

Parallel Session 4: Nanomaterials & Nanodevices

9:30am - 12:00pm EST

Swaminathan Rajaraman
Associate Professor
University of Central Florida



Prof. Rajaraman is a tenured Professor and a successful entrepreneur. He has published more than 110 articles in peer-reviewed journals and conferences, holds close to 45 patents/applications, and developed several products that are in volume production. His entrepreneurial activities include co-founding Axion BioSystems, Primordia BioSystems and recently Chrona Therapeutics. He was the Program Chair and General Chair for Hilton Head MEMS Workshop 2024 and 2026 and is the President of Transducer Research Foundation. His group has won several best paper and poster awards at most of the major MEMS & Sensors conferences. Prof. Rajaraman was a Nominee for Fellow of National Academy of Inventors (NAI) in 2025/26 and is the recipient of 2026 Research Incentive Award from UCF.

Micro/Nanosystems for Organs on a Chip, Diagnostics, and Therapeutic Applications

The natural applicability of micro and nano-scale technologies in life sciences, medical devices, and associated areas opens new avenues for powerful interdisciplinary collaboration between scientists, engineers, and medical professionals. My research group works on the development of hybrid micro/nanofabrication and embedded biosystems technologies to address applications in several areas including: (1) Organs on a Chip (OOCs); (2) Disease Diagnostics; and (3) Novel Therapeutics. This talk will introduce established and ongoing efforts in Dr. Rajaraman's lab in the space of these micro/nanoengineered technological areas that can help accelerate in vitro cellular research and develop novel diagnostics & therapeutics micro/nanosystems with groundbreaking biomedical applications.

Antonio Ruotolo
Professor
College of Charleston



Dr. Antonio Ruotolo is currently a Professor of Electrical Engineering at the College of Charleston, South Carolina, where he teaches courses of Circuits, Electronics and Microchip Design and Fabrication. He was the founding Chair of the Department of Engineering Physics of the Florida Polytechnic University, where he taught Semiconductor Physics and Devices. He has published papers in prestigious journals, including Nature Physics, Nature Nanotechnology and Advanced Materials, and he has attracted research funds from national agencies, such as the National Science Foundation, as well as private companies, such as Rolls Royce Solutions and Nephron Pharma. He has been granted 4 US patents. He was a Marie Curie post-doctoral fellow in the group of the Nobel Laureate Prof. A. Fert in France. He is an IEEE senior member and has served as Chair of the Hong Kong IEEE Magnetics Chapter from 2015 to 2019.

2D-silicon heterojunctions for infrared sensing

For years, scientists and engineers have tried to use 2D semiconductors as infrared absorbers. While the band-gap of 2D semiconductors can be engineered to be narrow enough to absorb infrared light, the concentration of photo-generated carriers would always be unreasonably small for practical applications, because unreasonably small is the volume involved. The proximity of a 2D semiconductor to silicon can significantly alter the energy bands of the latter near the interface. This proximity effect is not due to the penetration of the electronic wave-function of one material into the other, which is negligible in semiconductors. We have proven [1,2] that 2D films work as a potential-well for electrons, which results in a so-called hole-plasma in the silicon, therefore narrowing its optical band-gap. An increase of absorbance of intrinsic silicon in the near infrared by a factor 20 has been achieved. This factor decreases with increasing doping level. We have carried extensive investigation by using two different heterostructures, graphene/silicon and platinum-diselenide/silicon. X-ray photoemission spectroscopy shows that a change in the band structure of the bulk semiconductor near the interface is induced, leading to an overall narrowing of the optical band-gap. Furthermore, photo-induced Hall effect showed that an increase of photo-conversion efficiency by up to 20 times can be induced in the system, partially due to an extension of the absorbance spectrum to the infrared. Applications of this effect, such as infrared detection of laser beams and photo-voltaic will be discussed.

Azhar Ali
Professor
Virginia Tech



Dr. Azahar Ali is a tenure-track Assistant Professor in the School of Animal Sciences at Virginia Tech, where he leads research in biosensor engineering with a focus on precision animal farming and integrated health monitoring. He holds affiliate faculty appointments in Biological Systems Engineering and is affiliated with the Center for Advanced Innovation in Agriculture and the Center for Emerging Zoonotic and Arthropod-Borne Pathogens (CeZAP) at Virginia Tech. Dr. Ali's research bridges micro- and nanofabrication, additive manufacturing, and electrochemical sensing to develop deployable biosensors for agricultural, biomedical, and environmental applications. His work has been cited nearly 6055 times (h-index 46, i10-index 76). He is the recipient of several honors, including the Distinguished Alumni Award from IIT Hyderabad (2023) and the Virginia Tech By-Example Award (2025), recognizing his contributions to high-impact, translational biosensing technologies.

Printing the Future of Biosensing: From Nano-Biointerfaces to Integrated Health

Three-dimensional (3D) printing offers new opportunities to engineer bioelectronic interfaces with controlled geometry, high surface area, and nanoscale functionality for rapid and sensitive detection of biological targets. In this talk, I will present our recent advances in integrating 3D nanoprinting, functional nanomaterials, electrochemical transduction, and device-level additive manufacturing to create biosensing platforms spanning human and animal health. For human health applications, nanoprinted 3D electrodes functionalized with graphene-based nanomaterials provide highly responsive electrochemical interfaces for detecting antibodies, antigens, and disease-associated biomarkers. Hierarchical electrode architectures increase the accessible sensing surface and facilitate rapid electrochemical interrogation, enabling highly sensitive detection within seconds. Extending these principles to animal health, I will highlight 3D-printed multiplex sensing structures for measuring physiologically important ions and biomarkers directly in dairy milk. Engineered geometries and nanostructured interfaces enable rapid ion sensing and multidimensional assessment of physiological changes associated with metabolic and mammary health. I will also discuss emerging stereolithography-based 3D printing approaches for integrating sensing electrodes, fluidic pathways, and functional materials within compact analytical architectures. These studies illustrate a progression from nanostructured sensing surfaces to integrated bioelectronic devices and demonstrate how additive manufacturing across multiple length scales can enable versatile platforms for detecting biological targets ranging from antibodies and antigens to proteins and ions in complex biological samples.

Arash Takshi
Professor
University of South Florida



Dr. Arash Takshi is a Professor of Electrical and Computer Engineering at the University of South Florida. Before joining USF, Dr. Takshi was working as a Research Assistant at the University of Maryland, where he collaborated with a research group to develop wireless sensors for structural health monitoring systems. His current research interest is in novel materials and sensing modalities for the detection of gases and biosensors. Dr Takshi has more than 120 scientific publications and 12 patents. His research projects are funded through NSF, DoW, and Florida High Tech Corridor.

VOC Selectivity Trend in Metalated and Non-metalated Phthalocyanines

Phthalocyanines (Pcs) are synthetic porphyrin analogues with an 18-π electron structure that have recently gained interest in gas sensing applications. While their efficacy in gas sensing has been extensively explored, their interactions with volatile organic compounds (VOCs) remain underexplored. In this study, 6 Pcs (the metalated variants CoPc, CuPc, FePc, MgPc, ZnPc, and the metal-free variant H2Pc) have been tested against 4 commonly used VOCs (acetone, acetic acid, ethanol, and isopropanol) in a thin-film fashion fabricated on interdigitated Au electrodes (chemiresistor devices). H2Pc, lacking a metal center, serves as a baseline to assess the influence of metalation. MPcs and H2Pc responses towards VOCs were characterized through electrochemical tests (CV, and EIS), UV-vis, and SEM. Results from chemiresistors reveal responses are governed by adsorption of the analytes on the Pc surface; however, no particular signature response for any of the metalated phthalocyanines can be distinguished from H2Pc responses, suggesting that for sensing these weakly interacting agents at room temperature, the presence or absence of the metal center is not a defining factor.

Dmitri Voronine
Associate Professor
University of Central Florida



Dmitri Voronine is a Research Associate Professor at the NanoScience Technology Center, University of Central Florida, Orlando, FL. His research interests are in nano-optical imaging of quantum materials and biological systems using enhanced multidimensional spectroscopic techniques.

Novel Techniques for Nanoscale Cancer Imaging

Novel techniques for cancer imaging have been developed to target cancer-induced changes in physical and chemical cellular properties at the molecular level. Nanoscale morphological, electrical, and biochemical imaging provides new information about the cellular response to treatment. Novel approaches are based on scanning probe microscopy combined with optical vibrational and electronic spectroscopy and various signal enhancement nanoplasmonic mechanisms. Nanostructured metallic and semiconductor substrates are designed for simultaneous cancer treatment and imaging of the treatment efficiency. Advanced data processing based on multifractal analysis enables new biomarker design for disease diagnosis. Several nanoscale imaging techniques will be presented with applications to intact and unroofed ovarian cancer cells. Future directions to improve these technologies for clinical applications will be discussed.

Dilek Çökeliler Serdaroğlu
Professor
Baskent University



Dilek Çökeliler Serdaroğlu is a professor and chair in the Department of Biomedical Engineering at Baskent University, Ankara, Turkey (Accredited by MUDEK). Now, her research and teaching activities at Başkent University have emphasized on both various aspects of plasma surface modifications of biomaterials and nanofiber production with electrospinning technique / nanomaterial-based mass sensitive sensors. She is the recipient of several international patent awards (number: +8) including the L'ORÉAL Awards for Women in Science in 2009 In addition, she is a regular lecturer in the Intensive Summer Course: Biomedical Engineering in an International Perspective in Jade Hochschule Wilhelmshaven, Applied Engineering Science Department, Germany for 15 years.

Customizable and Modular Plasma-Beam Discharge Platform for Targeted Bio-Applications: From In-Situ Nanoparticle Fabrication to Direct Tissue Vaporization

Non thermal plasma exist far from thermodynamic equilibrium, enabling low-temperature processing and controllable plasma chemistry for materials and living tissues. Electrode configuration and operating conditions determine the plasma emission area, treatment efficacy, and applicability. Consequently, customizable device architectures are required for application-specific demands. This study presents two engineering strategies for tailoring high-voltage plasma discharges to material-processing and biomedical applications. First, a dense medium plasma based platform was established for rapid, high throughput single step nanoparticle synthesis. By introducing a novel electrode configuration engineered specifically to boost yield, stable discharges are initiated within a coexisting liquid vapor bubble medium. Second, a mechanically reconfigured probe with a modified pointed electrode was developed for spinal discectomy. The probe generated localized plasma capable of vaporizing herniated disc tissue while minimizing damage to surrounding tissues represents a key feature of this approach. The Design of Experiments framework was applied to evaluate both modules, which represents another innovative approach. The in situ synthesis of carbon–nitrogen and carbon–gold hybrid nanoparticles (size: 30 ± 10 nm) using dense medium plasma was demonstrated and validated through chemical characterization and cytotoxicity tests. A 2^4 factorial design and analysis of variance revealed that flow rate had a statistically significant effect on synthesis efficiency ($p<0.05$), yielding a maximum nanoparticle concentration of 25 mg/mL. Incorporating the synthesized nitrogen-doped carbon nanoparticles into a polymethyl methacrylate matrix increased its mechanical strength by 53 ± 4%, outperforming other carbon-based nanoparticle additives investigated. For direct tissue vaporization, scanning electron microscopy (SEM) confirmed a localized treatment spot with a diameter of 1.4 mm. Experiments using the new phantom model demonstrated spatial control and minimal collateral damage, as verified by SEM and atomic force microscopy. In addition, ex vivo Gram staining revealed vaporization boundaries, with limited chondrocyte loss and extracellular matrix degradation.

Hyeyoung Cho
Assistant Professor
Florida Polytechnic University



Hyeyoung Cho is an Assistant Professor in the Department of Biology, Chemistry, and Chemical Engineering at Florida Polytechnic University. Her research focuses on confined-fluid thermodynamics, nanoporous materials, and adsorption, with applications in energy and environmental systems. Her group uses differential scanning calorimetry (DSC), gas adsorption measurements, and materials characterization to study how nanoscale confinement affects fluid behavior.

Nanoconfinement-Induced Vapor Pressure Suppression of Hydrocarbons Revealed by Differential Scanning Calorimetry

Phase behavior of hydrocarbons under nanoscale confinement plays an important role in fluid recovery from tight-oil reservoirs, where a significant portion of hydrocarbons resides in nanoporous media. However, direct experimental measurements of phase transitions under confinement remain limited. In this work, the boiling behavior of heptane and toluene confined in mesoporous silica is investigated using differential scanning calorimetry (DSC) at pressures of 101, 700, and 1300 kPa. A well-defined mesoporous material (SBA-15, ~4 nm pore size) is used to isolate the effect of nanoscale confinement. The DSC measurements show clear shifts in phase-transition temperatures relative to the bulk fluids, corresponding to lower apparent vapor pressures for the confined hydrocarbons. This shift is consistently observed across all pressures tested, indicating that confinement-induced deviations persist under varying thermodynamic conditions. These results provide direct experimental evidence of nanoconfinement effects on hydrocarbon phase behavior and improve the understanding of confined-fluid thermodynamics in nanoporous materials.

Nathan J. Dawson
Associate Professor
Florida Polytechnic University



Nathan J. Dawson is an Associate Professor of Engineering Physics at Florida Polytechnic University. His research focuses on nonlinear optics, biological photonics, organic optical materials, photomechanics, and microcavity lasers. His research group's recent work explores naturally occurring biological photonic structures as active optical resonators, including demonstrations of amplified spontaneous emission and laser emission from fish iridophores and avian photonic architectures. He has also contributed to the development of photomechanical materials, self-healing optical materials, and bioinspired photonic devices. Dawson is a Senior Member of SPIE. He received his Ph.D. in Physics from Washington State University in 2010 and his B.S. in Physics from the University of Idaho.

Biological Nanophotonic Structures as Laser Resonators

Biological systems have evolved highly ordered nanophotonic architectures that manipulate light through interference and diffraction. By combining naturally occurring biological photonic structures with fluorescent gain media, it is demonstrated that these many of these nanostructures can support optical amplification and laser emission without conventional fabricated resonators. This recent work illustrates how biological nanophotonics can be used to study light-matter interactions. Amplified spontaneous emission (ASE) is demonstrated from salmon iridophores following fluorophore incorporation, while laser emission is achieved after dye-doping neon tetra iridophores. In neon tetra iridophores, periodic stacks of guanine crystal platelets provide distributed optical feedback where the threshold behavior and polarization-dependent emission is characterized. A theoretical model based on the Born approximation is shown to relate the structure to the observed laser emission. Peacock feather photonic architectures were also explored and were similarly shown to support coherent laser emission following dye infusion. Our recent laboratory results demonstrate that naturally evolved biological nanostructures can function as active optical resonators and could potentially provide new design strategies that complement conventional nanofabrication approaches. The optical functionality of some biological materials present new opportunities for bioinspired photonic devices and optical sensing as well as biomedical imaging and soft photonic technologies. Our continued investigation of biological nanophotonic systems is expected to reveal new mechanisms for controlling optical feedback and light amplification while offering a new means to produce biocompatible photonic materials and devices.

Tahniat Afsari
Post-Doc
University of South Florida



Tahniat Afsari, Ph.D., is a Postdoctoral Research Fellow at the University of South Florida, working in the Department of Molecular Medicine and the Department of Internal Medicine and Center for Research and Education in Nanomedicine & Bioengineering, Morsani College of Medicine. Her research lies at the intersection of nanotechnology, nanorobotics, mechanotransduction, and precision medicine, with a particular interest in developing remotely controlled nanosystems for biomedical applications. Her doctoral research focused on the design, fabrication, and dynamic assembly of nanorobotic systems, including externally actuated nanostructures with programmable individual and collective behaviors.

Calcium-Dependent Mechanotransduction Links Ultrasound-Induced Membrane to Endomembrane Permeability and Macromolecule Uptake in Glioblastoma Cells and Organoids

Ultrasound is a mechanical stimulus capable of triggering intracellular signaling responses, yet how this mechanical energy is transduced into a defined calcium-signaling and membrane-permeability program in glioblastoma cells a context in which calcium homeostasis is dysregulated relative to normal tissue remains incompletely understood. Here, we show that low-intensity pulsed ultrasound induces transient plasma membrane permeabilization in GL261 murine glioblastoma cells, accompanied by a rapid Fluo-4-detected rise in intracellular Ca^{2+}, without compromising long-term cell viability.This ultrasound-induced Ca^{2+} influx is associated with a calcium-dependent increase in endomembrane permeability. Intracellular calcium chelation with BAPTA-AM suppresses both Galectin-8 puncta formation and LysoTracker signal loss, providing two mechanistically complementary readouts of endomembrane disruption: Galectin-8 reports cytosolic exposure of glycans following membrane damage, whereas LysoTracker signal loss reflects disruption of acidic endolysosomal compartments. As functional readouts of this permeabilized state, ultrasound-treated cells exhibit size-dependent dextran uptake, with enhanced entry of 10 kDa but not 70 kDa dextran, together with redistribution of internalized cargo away from the perinuclear endolysosomal compartment. Ultrasound also increases intracellular uptake of the fluorescent oligonucleotide siGLO in both GL261 monolayers and GL261-derived three-dimensional organoids. Together, these findings define a calcium-dependent mechanotransduction pathway linking ultrasound-induced plasma membrane permeabilization and Ca^{2+} influx to altered endomembrane permeability and intracellular cargo trafficking in glioblastoma. Furthermore, size- and calcium-dependent macromolecular and oligonucleotide uptake provides a functional signature of this mechanotransductive response across both two- and three-dimensional glioblastoma models.

Parallel Session 5 and 6 Moderators

Nathan Dawson
Associate Professor
Florida Polytechnic University



Nathan J. Dawson is an Associate Professor of Engineering Physics at Florida Polytechnic University. His research focuses on nonlinear optics, biological photonics, organic optical materials, photomechanics, and microcavity lasers. His research group's recent work explores naturally occurring biological photonic structures as active optical resonators, including demonstrations of amplified spontaneous emission and laser emission from fish iridophores and avian photonic architectures. He has also contributed to the development of photomechanical materials, self-healing optical materials, and bioinspired photonic devices. Dawson is a Senior Member of SPIE. He received his Ph.D. in Physics from Washington State University in 2010 and his B.S. in Physics from the University of Idaho.

Swadeshmukul Santra
Professor
University of Central Florida



Swadeshmukul Santra, Ph.D. is a Professor at the University of Central Florida holding a joint appointment with the NanoScience Technology Center and the Department of Chemistry. Dr. Santra is the founding director of UCF Materials Innovation for Sustainable Agriculture (MISA) Center. He has been actively working in the field of Nanoscience and Nanotechnology for over 20 years focusing on nanoagriculture and nanomedicine areas. He has published over 100 peer-reviewed research articles, 8 review articles, 12 book chapters and delivered 96 invited talks. He has been awarded 35 patents including 28 US patents.

Parallel Session 5 and 6 Moderators

Swaminathan Rajaraman
Associate Professor
University of Central Florida



Prof. Rajaraman is a tenured Professor and a successful entrepreneur. He has published more than 110 articles in peer-reviewed journals and conferences, holds close to 45 patents/applications, and developed several products that are in volume production. His entrepreneurial activities include co-founding Axion BioSystems, Primordia BioSystems and recently Chrona Therapeutics. He was the Program Chair and General Chair for Hilton Head MEMS Workshop 2024 and 2026 and is the President of Transducer Research Foundation. His group has won several best paper and poster awards at most of the major MEMS & Sensors conferences. Prof. Rajaraman was a Nominee for Fellow of National Academy of Inventors (NAI) in 2025/26 and is the recipient of 2026 Research Incentive Award from UCF.

Parallel Session 5: Nanotechnology Applications | 2:15 - 3:55pm EST

Jaspreet Dhau
Vice President of R&D
Molekule Group Inc.



Dr. Jaspreet Dhau is the Vice President of Research and Development at Molekule, bringing more than 20 years of extensive research experience in both academia and private industry. Dr. Dhau has successfully commercialized eight technologies and spearheaded over 20 research and product development initiatives, including projects funded by the US Department of Defense. In 2022, he was recognized by the National Academy of Inventors as one of the world's top emerging inventors. Dr. Dhau's research specialties encompass indoor air purification, photocatalysis, fluorine-free firefighting foams, coatings and coating removal technologies. Dr. Dhau has secured 25 granted patents, and his scholarly contributions include over 65 peer-reviewed research articles published in leading scientific journals.

Sustainable Class B Fire Suppression Using Ionic Liquid-Based Fluorine-Free Firefighting Foam

For over five decades, aqueous film-forming foams (AFFFs) have been successfully used in Class B fire suppression operations. AFFFs contain per- and polyfluoroalkyl substances (PFAS) that enable ultralow interfacial tension, positive spreading behavior, and the formation of a thin aqueous film at the fuel–foam interface. However, the environmental persistence, bioaccumulation potential, toxicity, and poor biodegradability of fluorochemicals, including perfluoroalkyl carbonates, perfluoroalkyl sulfonates, and fluorotelomer sulfonates, have created an urgent need for fluorine-free formulations that can replace legacy AFFF formulations. Existing fluorine-free foams typically rely on hydrocarbon surfactant packages that can generate stable foam blankets but often do not form a persistent fuel-surface film, resulting in reduced vapor sealing and limited burn-back resistance under harsh fuel-fire conditions.

The present study describes a fluorine-free ionic liquid-based firefighting foam engineered for Class B fuels, including jet fuel and gasoline. The ionic liquid scaffold is designed to promote favorable surface and interfacial activity without per- or polyfluoroalkyl substances, yielding a spreading coefficient of 2–3 mN/m, enhanced foam drainage characteristics, and compatibility with hot fuel and fuel vapors. Fire-extinguishment efficacy was validated using 28 ft2 large-scale pan-fire testing with jet fuel and gasoline. The formulation met MIL-PRF-32725 performance criteria for both fuels, achieving extinguishment in 24 s for jet fuel and 36 s for gasoline. Burn-back resistance was 580 s for jet fuel and 525 s for gasoline, indicating durable post-extinguishment vapor suppression and thermal resilience of the foam blanket. The formulation also maintained benchmark performance at half-strength concentration, demonstrating robustness to dilution and potential operational efficiency. Collectively, these results establish ionic liquid-based formulations as a technically viable pathway for fluorine-free Class B firefighting foams that combine environmental compatibility with performance metrics approaching those of conventional AFFFs.

Jin He
Professor
Florida International University



Dr. Jin He is a professor in the Physics Department of Florida International University (FIU) at Miami, USA. He received his BS degree in Physics from Fudan University in 1999 and Ph.D. degree in Biophysics from Arizona State University (ASU) in 2005. He continued to work as a postdoc and assistant research professor in the Center for Single-Molecule Biophysics at the Biodesign Institute of ASU before joining FIU at 2011. Dr. He is generally interested in the electron and ion transport at the nanoscale, molecular physics, biophysics and the development of new methods and instruments for biomedical applications. His research areas are quite interdisciplinary, including molecular electronics, nanobiotechnology and single molecule cellular biophysics. He has authored over 90 peer-reviewed publications in these areas.

Probing Molecular Interactions by a Glass Nanopipette

In this talk, I will present our recent efforts to develop nanopipette-based techniques for detecting and probing dynamic molecular interactions at the nanoscale. Glass nanopipettes, a versatile subtype of solid-state nanopores, have become increasingly popular due to their simple, low-cost and brad applicability. These techniques enable label-free, high-throughput, real-time and in situ investigations of molecular interactions down to the single-molecule level. We have developed a new approach to induce self-crowding of small molecules at the nanopipette tip, leading to enhanced event rate and signal to noise ratio for the detection of small molecules using time-resolved ionic current signals. We further used this approach to study various interactions involving small molecules in a crowded environment. The structure of molecular complex can also be revealed with exceptional sensitivity. In another example, we developed new methods to form stable nanoscale lipid membranes on the nanopipette tip and applied these methods to probe the detailed interactions between individual antimicrobial peptide and lipid bilayer membranes. We revealed the dynamic and voltage-gated pore-forming process of peptide channel on the membrane.

Ateet Dutt
Professor
National Autonomous University of Mexico



Dr. Ateet Dutt is currently the head of the Nanosensors Group at the Materials Research Institute at the National Autonomous University of Mexico (UNAM). He is also on the Board of Directors of the Mexican Society of Surfaces, Materials, and Vacuum, and organizes various symposia at materials-related conferences. He has published several articles in international peer-reviewed journals and one edited book on Nanosensors. One of his Mexican patents has been granted, and the others 3 are being processed. He has participated in more than 120 international conferences and more than 45 invited talks at different national and international platforms. He is awarded as a member of the National Researchers System (Mexico) (level II), awarded by the National Council of Science and Technology of Mexico (SECIHTI).

Nanowires for Health: Science and Applications

Semiconductor nanowires represent a promising platform for the development of innovative technologies in the healthcare sector, owing to their high surface-to-volume ratio, tunable electronic properties, and ease of surface functionalization. This talk will present recent advances in the design and synthesis of metal oxide nanowires—specifically ZnO—with a focus on biomedical applications. Their use as multifunctional platforms for the detection and treatment of antibiotic-resistant bacteria will be discussed, highlighting the underlying physicochemical mechanisms, such as the generation of reactive oxygen species and surface-pathogen interactions. Additionally, the influence of structural parameters—such as diameter, length, and heterostructure formation—on device sensitivity, selectivity, and biocompatibility will be analyzed. Finally, the talk will address prospects for developing smart nanosystems capable of integrating diagnostics and therapeutic action, thereby contributing to the fight against antimicrobial resistance and the advancement of nanomedicine.

Bradford A. Barker
Assistant Professor
Florida Polytechnic University



Bradford A. Barker is an assistant professor at Florida Polytechnic University, from 2024 to present. Prof. Barker is currently exploring the development of quantum algorithms for electronic structure theory with undergraduate students at Florida Polytechnic University. The work presented at Nano Florida 2026 was begun during Dr. Barker's second postdoc at the University of California, Merced, under the supervision of Prof. Elizabeth Nowadnick and in collaboration with Sinead M. Griffin at Lawrence Berkeley National Laboratory. While working on a National Science Foundation funded project on spin-electric coupling in magnetic ion-doped ferroelectric oxides, the authors recognized a need for tabulation of magnetic anisotropy energy equations, which allowed Dr. Barker to rediscover his passion for the subject of group theory.

Magnetic Anisotropy Energy Functions for All point Groups to Sixth Order

Magnetic anisotropy energy (MAE) functions indicate the preferred orientations of the magnetic moments of magnetic ions within a solid or molecule, or on a surface. The point group of the environment about the magnetic ion determines the shape of these MAE functions. While there are adequate references that list these functions to sixth order in the sine of the polar angle for tetragonal, hexagonal, and cubic crystalline systems, we derive in this work the MAE functions to sixth order for all point groups, including the 32 crystallographic point groups, as well as all non-crystallographic point groups. We explicitly determine the MAE functions for 25 non-crystallographic point groups relevant for molecules, while all remaining point groups with symmetry axes larger than six-fold necessarily have a simple form, to sixth order. We describe the procedure for arriving at these functions, extending the results beyond sixth order as needed, as well as providing Python code that allows for calculating the MAE constants from first-principles energy data.

Matthew Smyle
Associate Professor
Hofstra University



Dr. Smylie's primary research focus is the characterization of exotic superconductors like bulk ferromagnetic superconductors and candidate topological superconductors. He received his PhD at the University of Notre Dame and was a postdoctoral researcher at Argonne National Laboratory before joining Hofstra University, where he is an Associate Professor in the Department of Physics and Astronomy. A passionate educator, Smylie was Teacher of the Year at Hofstra, is both a former Fulbright and Goldwater scholar, and is very involved in faculty self-governance and student mentoring.

The importance of nanoscale defects in both applied and fundamental superconductivity research

Creating nanoscale defects in superconductors is a vital part of engineering high- performance superconducting wires as well as a useful tool for exploring the fundamental physics of exotic superconductors. Defects pin magnetic vortices, enhancing the maximum current-carrying capability of superconducting wires. Defects also create disorder scattering, which can reveal information about the energy gap separating normal electrons from superconducting electrons. In this talk, I will discuss nanoscale defects, their creation, and how they impact superconductors.

Sudip Majumder
Post-Doc
University of South Florida



Dr. Sudip Majumder is an experimental condensed matter physicist specializing in Hybrid magnonics, spintronics, and ultrafast magnetization dynamics. He earned his Master's degree in Physics and completed his Ph.D. at the S. N. Bose National Centre for Basic Sciences, India. Prior to joining the University of South Florida, Dr. Majumder worked as a Research Scientist on THz nanomaterial under the Technical Research Cell Project. He has authored more than 15 research papers in leading peer-reviewed international journals.

Temperature-Dependent Spin Pumping in FeCoGd/Pt Bilayers

Rare-earth–transition-metal (RE–TM) ferrimagnets host two exchange-coupled angular-momentum reservoirs—localized 4f moments and itinerant 3d electrons—whose roles in interfacial spin transport remain incompletely understood [1]. We investigate spin pumping in FeCoGd/Pt bilayers using broadband ferromagnetic resonance, extracting the Gilbert damping and effective spin mixing conductance ($g^{\uparrow\downarrow}_{eff}$) across TM-rich and RE-rich compositions over a wide temperature range. TM-rich samples show a largely ferromagnet-like trend: damping increases upon cooling due to intraband electron scattering and exchange-driven magnetic rigidity, while $g^{\uparrow\downarrow}_{eff}$ decreases monotonically as both Pt spin absorption and the transverse dynamics of the TM 3d sublattice are progressively suppressed. RE-rich samples exhibit a qualitatively distinct, non-monotonic response: both damping and $g^{\uparrow\downarrow}_{eff}$ initially decrease as thermally activated rare-earth spin fluctuations are reduced, weakening RE-mediated dissipation and coherence of transverse spin-current generation. At low temperatures, strong antiferromagnetic 4f–3d exchange rigidly couples the sublattices, enabling coherent angular-momentum transfer from localized Gd moments to itinerant FeCo electrons, which directly inject spin current into Pt [2]. This exchange-mediated conversion produces a characteristic low-temperature recovery of spin pumping unique to the RE-rich regime. The contrasting behaviors demonstrate that interfacial spin transparency in ferrimagnets is governed jointly by interface scattering, nanoscale exchange coupling, and temperature-dependent sublattice imbalance, establishing $g^{\uparrow\downarrow}_{eff}$ as an internally regulated, dynamic quantity rather than a fixed interfacial constant [3].

References:
[1] Kim et al., Nat. Mater. 21, 24 (2022).
[2] Kim et al., Phys. Rev. Lett. 122, 127203 (2019).
[3] Kamra et al., Phys. Rev. B 98, 184402 (2018)

Parallel Session 6: Nanotechnology Applications | 2:15 - 3:55pm EST

Beni Dangi
Associate Professor
Florida A&M University



Dr. Dangi joined Department of chemistry at Florida A&M University as an assistant professor in the Fall of 2016, and was promoted to associate professor with tenure in 2022. In addition to teaching and research, Dr. Dangi is equally interested in professional and community services. Some of the examples include serving in the executive committee of the Florida section of the American Chemical Society, review committee of the Florida state high school teacher licensing, university faculty senate of FAMU, NASA proposal review team, and science, technology, and innovation committee of the Non-Resident Nepali Association of the U.S.A.

Understanding Hydrocarbon Growth on Refractory Surfaces: Combined Experimental and DFT Studies

We used a combination of laser-induced experiments and density functional theory (DFT) calculations to study the mechanism of growth of carbonaceous species on the reactive surfaces, Si, Mg and Ge. Experimental observations revealed that the carbon deposit forms upon laser illumination on the surfaces, with the deposit being better structured from 1,3-butadiene (C_4H_6) compared to ethylene (C_2H_4) gas. Experiments were performed under controlled pressures and gas compositions and products were characterized by Raman spectroscopy and Scanning Electron Microscopy. DFT thermodynamic and kinetic calculations of C2–C4 hydrocarbons interaction on stable bulk refractive surfaces were used to explain this experimental observation. Our results showed that the hydrocarbon gases freely adsorb onto the surfaces, propagate through dehydrogenation and radical additions and ultimately form nano-sized refractory carbonaceous materials. Implications of these in astrochemical environments and chemical sensor development will be discussed.

Emadelden Fouad
Associate Professor
Florida Polytechnic University



Emadelden Fouad serves the Department of Engineering Physics of Florida Polytechnic University as an Associate Professor. His research interests include, but are not limited to, quantum transport characteristics of energy-efficient devices, electromagnetic properties of type II superconductors, and emerging nanomaterials like graphene.

Transfer-Matrix Design of a Ternary Photonic Crystal Nanocavity for Skin-Cancer Refractive-Index Discrimination

Photonic crystals built from nanoscale dielectric thin films can trap light in a narrow cavity resonance whose wavelength shifts with the refractive index (RI) of material placed inside the cavity. Using transfer-matrix simulations, we study a symmetric three- material stack, Air/(MgF2/SiON/TiO2)N/D/(MgF2/SiON/TiO2)N/Glass, in which the central defect layer D holds the sample. The sample RIs are taken from published values for melanoma (ME), basal cell carcinoma (BCC), and squamous cell carcinoma (SCC). The structure creates a near-infrared photonic bandgap from 905.0nm to 1342.3nm. Within this bandgap, each tissue type produces its own resonance. The computed sensitivity is 646–652nmRIU−1, the quality factor is about 31,200–31,600, and the figure of merit is roughly 19,800–20,000RIU−1. These values treat the mirror materials as lossless (k = 0) within experimental precision and do not include losses in the defect layer or the sample. The resonances are 5.83–46.93nm apart, which is 178–1654 times the resonance linewidth. A Monte Carlo analysis of RI uncertainty shows that separating melanoma from BCC and from SCC is robust, with a reversal probability of 12.6% or less. We treat the BCC–SCC separation as preliminary because the SCC index comes from an oral-mucosa proxy. Compared with an equivalent two-material design, the three-material stack raises the figure of merit at the melanoma resonance by about 3.1×. These results show that the published RI values can be resolved optically. Clinical discrimination of skin lesions will still require skin-specific measurements and experimental validation. Keywords: photonic crystal nanocavity, thin-film multilayer, transfer matrix method, refractive index sensing, skin cancer, near-infrared biosensing

Atiya Banerjee
Post-Doc
University of Central Florida



Dr. Banerjee is a Postdoctoral Research Associate at the University of Central Florida (UCF), focusing on catalysis for renewable energy and nano-agricultural applications, including the design of nitrogen reduction catalysts using machine learning. Prior to joining UCF, Dr. Banerjee completed postdoctoral research at Brookhaven National Laboratory from Divisions of Chemistry and Center for Functional Nanomaterials. This work involved characterizing alumina surfaces, investigating the diiron active sites of monooxygenases, and utilizing density functional theory and machine learning to predict Mössbauer parameters of mono-iron and diiron complexes in addition to his expertise carried from PhD on mono-iron biological active sites. Dr. Banerjee's broader research interests include molecular modeling, nanomaterial design, functional catalysis, and cheminformatics.

Computational Design of Nano-Agrochemicals: Insights into Interfacial Binding, Complexation and Assembly

The structural and dynamical properties of complex nanomolecular systems are fundamentally governed by their interfacial environments and non-covalent interactions. This presentation explores these phenomena through advanced computational modeling and molecular dynamics across three conceptually linked systems, spanning from inorganic surface binding to bio-macromolecular assemblies. First, we investigate the interfacial thermodynamics of advanced material systems, specifically detailing the binding mechanisms of Na2Sx polysulfides to magnesium hydroxide (Mg(OH)2) surfaces. By mapping the adsorption energetics and charge transfer at the solid-liquid interface, this work provides atomic-level insights into surface passivation and the mitigation of polysulfide diffusion. Building upon these fundamental principles of interfacial and solvent-solute interactions, the research transitions to multi-component polymeric systems. Utilizing molecular dynamics simulations within explicit ethanol-water solvent environments, we modeled the phase behavior and assembly of curcumin borate complexes, tannic acid, and polyvinylpyrrolidone. These simulations capture the molecular packing and stabilization mechanisms driven by complex hydrogen bonding networks and hydrophobic interactions, elucidating the thermodynamic drivers of ternary polymer-drug complexation. Finally, we extend these computational methodologies to nucleic acid delivery architectures, focusing on the structural dynamics of zein-chitosan complexes associating with plasmid DNA. Through rigorous charge density analysis, we map the electrostatic landscape to approximate the zeta potential of the formulated complex, providing a computational basis for evaluating its colloidal stability and binding affinity. The simulations reveal the specific mechanisms of attachment between the cationic protein-polysaccharide matrix and the anionic DNA architecture. By bridging inorganic surface chemistry, small-molecule polymer complexation, and macroscopic DNA structural behavior, this overarching computational framework yields critical predictive insights into the stability and interactivity of highly complex chemical systems, offering direct implications for materials design and therapeutic delivery.

Josep Ramon Codina
Post-Doc
University of Miami



Josep Ramon Codina is a skilled professional with a strong background in proteomics and genomics, complemented by hands-on experience in bacterial, mammalian, and viral cell cultures and assays. He holds a leadership position in Data Management and Strategy at Nucleate, where he ensure data homogeneity and automation across departments, fostering collaborations.
Dr. Codina's expertise spans across high-performance computing environments, molecular docking, machine learning integration, and a variety of biochemical assays and analytical techniques. These skills are continuously updated as he pursue further advancements in the field, as documented in my publications and ongoing projects.

Accelerating the Screening of Clamp Peptides Against Respiratory Viruses

Rapid urbanization, migration, and climate change are accelerating the emergence and diversification of respiratory viruses, while therapeutic discovery remains too slow for outbreak response. We present Clamp Peptides (CPs), fully synthetic 17-21 amino acid antiviral ligands designed to grip conserved receptor-binding regions of viral surface proteins. Each CP contains two binding arms connected by a flexible linker, enabling simultaneous engagement of adjacent epitopes to improve binding stability. Using structure-guided peptide-protein docking, peptide library screening, and retrospective machine-learning triage, we designed CPs targeting severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) spike and influenza A hemagglutinin. Candidate peptides were characterized and evaluated for binding, cytotoxicity, hemolysis, and antiviral activity in human tissue-engineered three-dimensional (3D) lung models. Lead CPs blocked viral entry across multiple SARS-CoV-2 variants and influenza A strains by 2-4 log10 without detectable cytotoxicity or hemolysis at therapeutically relevant concentrations. Because CPs are synthetic, reproducible, and rapidly redesignable, they offer a scalable, broad-spectrum, variant-agnostic platform for intranasal delivery at the airway mucosa and a potential first-line countermeasure against emerging respiratory viruses.

Aakash Nathani
Post-Doc
Florida A&M University



Mr. Aakash Nathani is currently a Graduate Student (Ph.D. in Pharmaceutical Sciences) at the College of Pharmacy and Pharmaceutical Sciences, Florida Agricultural and Mechanical University. He is also currently serving as the Chair of Florida A&M University's AAPS student chapter and has previously served as Vice-chair. He is also associated to FAMU's NanoStrike club as current President of the club. He was inducted as the student ambassador for Global Association of Nanotechnology at NanoFlorida Conference in Miami in 2025. His research interests include co-crystals, drug formulation, transdermal drug delivery, exosomes, and 3D printing. His current project deals with exploration of extracellular vesicles from immune cells and milk for their anticancer properties for lung and breast cancer immunotherapy.

Multiplex Cytokine and NK-Associated Secretome Profiling Demonstrates Immune Reprogramming by miR-34a-Loaded Lyophilized NK Exosomes in Lung Cancer

This study developed miR-34a-5p-loaded lyophilized natural killer (NK) cell-derived exosomes as a stable therapeutic platform and evaluated their physicochemical characteristics, sustained release, antitumor efficacy, molecular mechanisms, and immunomodulatory effects in lung cancer models. NK92-MI cells were expanded in an Electric and Chemical Hypoxia Optimized (ECHO) bioreactor to enhance exosome production. Exosomes were isolated, lyophilized using an optimized cryoprotectant formulation, loaded with miR-34a-5p by electroporation, and characterized by nanoparticle tracking analysis, transmission electron microscopy, agarose gel electrophoresis, western blotting, zeta potential analysis, and controlled release studies. Therapeutic efficacy was evaluated in Lewis lung carcinoma (LLC) and patient-derived xenograft (PDX) lung cancer models through cytotoxicity, cell-cycle analysis, signaling pathway evaluation, multiplex cytokine profiling, NK-associated secretome analysis, immune-cell co-culture studies, and in vivo antitumor efficacy. Lyophilized miR-34a-5p-loaded NK exosomes maintained structural integrity, preserved exosomal and NK-associated protein expression, demonstrated sustained miRNA release, and remained stable during long-term storage. Treatment significantly reduced tumor cell viability, induced S-phase cell-cycle arrest, activated the stimulator of interferon genes (STING)/TANK-binding kinase 1 (TBK1)/interferon regulatory factor 3 (IRF3)/signal transducer and activator of transcription 1 (STAT1) signaling axis, suppressed protein kinase B (AKT) and cyclin-dependent kinase 6 (CDK6), reduced pro-inflammatory cytokines, enhanced secretion of natural killer effector molecules including perforin, granzyme B, granulysin, and interferon-γ, increased antitumor immune responses, and markedly inhibited tumor growth, particularly in combination with paclitaxel.

Nathaniel G. Hermann
Assistant Professor
Florida Polytechnic University



I am an Assistant Professor of Physics at Florida Polytechnic University. My main research interest is microfluidic devices, spanning from theoretical models of various in-device transport phenomena to applications in New Approach Methodologies (e.g., organ-on-a-chip devices). I am currently investigating information transport and signal fidelity in microfluidic devices, alternative methods of mold fabrication for microfluidics, and applying regression-based models to simulate microfluidic systems.

Modeling Transport Phenomena for Dosing Control in Organ-on-a-Chip Devices

Microfluidic devices, such as organ-on-a-chip devices (OOCs), are an important new approach methodology in biomedicine. OOCs, in particular, are vital to future pharmacological and toxicological research as a replacement for animal studies, both satisfying new regulatory guidelines and providing better representation of human response. However, critical concerns remain about dosing control inside OOCs. We present an integrated framework to model in-device chemical concentrations by accounting various transport phenomena, including fluid, chemical, and information transport. With this framework, one may devise protocols to achieve desired in-device dosing schemes and determine operational regimes for in-device periodic chemical signaling.

Ahmed Abosalha
Post-Doc
McGill University



Dr. Ahmed Abosalha is a postdoctoral researcher at McGill University, where his research focuses on nanomedicine and RNA-based therapeutics for cancer treatment. He earned his PhD in Biological and Biomedical Engineering from McGill University, where he developed tailored nanocarriers for the delivery of RNA interference-based therapeutics. His research interests include nanoparticle-based drug and gene delivery, RNA interference, cancer nanomedicine, and targeted therapeutic strategies. He also holds a Master's degree in Pharmaceutical Technology and a Bachelor's degree in Pharmacy from Tanta University, Egypt, where he has served as a faculty member in the Faculty of Pharmacy. His work bridges pharmaceutical sciences, nanotechnology, and molecular medicine to advance innovative cancer therapies.

Nanoparticles-Mediated Anti-miRNA 21 Delivery: A Next-Generation Approach to Colorectal Cancer Therapy

RNA interference (RNAi)-based therapeutics offer a promising approach for modulating disease-associated genes involved in cancer progression. MicroRNA-21 (miRNA 21) is frequently overexpressed in colorectal cancer (CRC) and has been implicated in tumor progression, making its inhibition using an anti-miRNA 21 oligonucleotide (antagomir) a potential therapeutic strategy. However, the therapeutic application of RNA molecules is limited by their susceptibility to nuclease-mediated degradation, rapid renal clearance, and recognition and uptake by the reticuloendothelial system (RES). Therefore, nanocarrier-based delivery systems are needed to protect RNA molecules and enhance their cellular delivery. In this study, poly (lactic-co-glycolic acid) (PLGA) nanoparticles were developed as a nanocarrier for anti-miRNA 21 delivery. The nanoparticles were characterized for particle size, surface charge, and morphology using dynamic light scattering, zeta potential analysis, and transmission electron microscopy, respectively. Cellular uptake was subsequently evaluated to assess intracellular delivery, while PTEN expression was investigated as a preliminary indicator of biological activity. The developed nanoparticles demonstrated favorable nanoscale physicochemical characteristics and enhanced cellular uptake of the anti-miRNA 21 payload. Furthermore, anti-miRNA 21-loaded nanoparticles were associated with modulation of PTEN expression, supporting successful intracellular delivery and biological activity. Overall, these preliminary findings highlight the potential of PLGA nanoparticles as a platform for overcoming key barriers to anti-miRNA 21 delivery and advancing RNAi-based nanotherapeutics for colorectal cancer.

Subhash C. Chauhan
Director
The University of Texas Rio Grande Valley



Subhash Chauhan, PhD, is the Director of the South Texas Center of Excellence in Cancer Research at the UTRGV School of Medicine. Dr. Chauhan earned his PhD from the Central Drug Research Institute in Lucknow, India. He later joined the University of Tennessee Health Science Center faculty, where he served as a professor in the Department of Pharmaceutical Sciences in the College of Pharmacy and Cancer Research Center. Dr. Chauhan is an accomplished researcher with 24 years of experience in cancer immunology research, and he has garnered several high-award grants from the National Institutes of Health. He currently serves as Chair of the Department of Immunology and Microbiology at the UTRGV School of Medicine.

Targeted Therapies for Pancreatic Cancer

By 2030, pancreatic cancer (PanCa) is projected to be the second leading cause of cancer-related deaths. The early diagnosis and treatment of PanCa remains a clinical challenge, predominantly due to the lack of effective diagnostic biomarkers and targeted therapies. Therefore, the scientific community is making tremendous efforts toward the identification of novel early diagnostic markers, as existing biomarkers, including CA19-9, have yielded only suboptimal efficacy in early-stage detection. Mucins are high molecular weight glycoproteins found in mucus that play an important role in diverse biological functions, such as differentiation, cell adhesion, immune response, and cell signaling. Altered mucin expression can be seen in a variety of diseases, including cancer. Recent studies have suggested that high expression of MUC13, a newly identified epithelial cell surface mucin, in PanCa and the overexpression of MUC13 in PanCa cells lead to enhanced tumorigenic and metastatic phenotypes. These characteristics of PanCa cells are mediated by physical interactions between MUC13 and HER2/Neu. Additionally, MUC13 expression inversely correlates with the expression of the tumor suppressor microRNA-145 (miR-145). In addition to our previous studies, the potential role of MUC13 in pancreatic pathophysiology has also been recognized by other institutions. In this lecture, we will provide a comprehensive investigation of MUC13 expression using our newly generated anti-MUC13 monoclonal antibody (MAb) in a large cohort of human PanCa tissue samples. The expression pattern and subcellular localization of MUC13 will be discussed to demonstrate its correlation with early PanCa diagnosis, patient's clinical course, and prognostic significance. We will discuss how MUC13 expression can be useful to discriminate low- and high-malignant-potential early lesions of PanCa (such as PanIns, IPMNs, MCNs). Additionally, we will provide information on how MUC13 expression can be useful for developing advanced, targeted molecular therapeutics for effective PanCa treatment.

Parallel Session 7 and 8 Moderators

Swadeshmukul Santra
Professor
University of Central Florida



Swadeshmukul Santra, Ph.D. is a Professor at the University of Central Florida holding a joint appointment with the NanoScience Technology Center and the Department of Chemistry. Dr. Santra is the founding director of UCF Materials Innovation for Sustainable Agriculture (MISA) Center. He has been actively working in the field of Nanoscience and Nanotechnology for over 20 years focusing on nanoagriculture and nanomedicine areas. He has published over 100 peer-reviewed research articles, 8 review articles, 12 book chapters and delivered 96 invited talks. He has been awarded 35 patents including 28 US patents.

Swaminathan Rajaraman
Associate Professor
University of Central Florida



Prof. Rajaraman is a tenured Professor and a successful entrepreneur. He has published more than 110 articles in peer-reviewed journals and conferences, holds close to 45 patents/applications, and developed several products that are in volume production. His entrepreneurial activities include co-founding Axion BioSystems, Primordia BioSystems and recently Chrona Therapeutics. He was the Program Chair and General Chair for Hilton Head MEMS Workshop 2024 and 2026 and is the President of Transducer Research Foundation. His group has won several best paper and poster awards at most of the major MEMS & Sensors conferences. Prof. Rajaraman was a Nominee for Fellow of National Academy of Inventors (NAI) in 2025/26 and is the recipient of 2026 Research Incentive Award from UCF.

Parallel Session 7 and 8 Moderators

Emadelden Fouad
Associate Professor
Florida Polytechnic University



Emadelden Fouad serves the Department of Engineering Physics of Florida Polytechnic University as an Associate Professor. His research interests include, but are not limited to, quantum transport characteristics of energy-efficient devices, electromagnetic properties of type II superconductors, and emerging nanomaterials like graphene.

Arash Takshi
Professor
University of South Florida



Dr. Arash Takshi is a Professor of Electrical and Computer Engineering at the University of South Florida. Before joining USF, Dr. Takshi was working as a Research Assistant at the University of Maryland, where he collaborated with a research group to develop wireless sensors for structural health monitoring systems. His current research interest is in novel materials and sensing modalities for the detection of gases and biosensors. Dr Takshi has more than 120 scientific publications and 12 patents. His research projects are funded through NSF, DoW, and Florida High Tech Corridor.

Parallel Session 7: Semiconductors Education & Research

9:00 - 11:00am EST

Ashok Kumar
Professor
University of South Florida



Dr. Ashok Kumar is a Professor in the Department of Mechanical and Aerospace Engineering at the University of South Florida (USF), Tampa. He previously served as Director of the Nanotechnology Research and Education Center (NREC) and is an affiliated faculty member of the Clean Energy Research Center (CERC). Dr. Kumar holds 12 US patents and has published 3 textbooks, edited 7 proceeding books, 3 invited review articles, 12 book chapters including 236 peer reviewed articles (approx. 132 journal articles and 104 conference proceeding articles) and has presented approximately 316 papers in regional and national conferences including 51 invited talks. He has a strong commitment to integrating research and education with experience as an active member (PIs) for various NSF Grants (NRT, GK-12, S-STEM, REU & RET Sites etc.).

Interdisciplinary Convergent Research and Education for Semiconductor Workforce Development

The 2022 CHIPS and Science Act and the 2020 National AI Initiative Act underscore the urgent national need for a highly skilled workforce in semiconductor manufacturing and artificial intelligence/machine learning (AI/ML). In response to this need, a recent NSF National Research Traineeship (NRT) award to the University of South Florida (USF) supports the development and implementation of a comprehensive, experiential-learning-based program focused on semiconductor design, manufacturing, and packaging. This talk will highlight interdisciplinary semiconductor concepts and emerging technologies being integrated into existing curricula, complemented by innovative hands-on laboratory training in a Class 1000 cleanroom environment. Students collaborate with industry partners to identify real-world research challenges and, using a convergence-based approach, design and develop application-driven semiconductor systems and devices. The program is uniquely structured to equip graduates with essential competencies in transdisciplinary knowledge, communication and teamwork, experimental and computational methods, informed decision-making, entrepreneurship, project management, ethics, leadership, and safe and sustainable manufacturing practices. Students interested in entrepreneurship also have opportunities to participate in NSF I-Corps training. In addition, the talk will provide an overview of the current semiconductor industry landscape, emerging workforce needs, and career and job opportunities in semiconductor design, manufacturing, advanced packaging, and related technologies. The presentation will highlight how interdisciplinary education and experiential research can prepare students for high-demand careers and contribute to strengthening the U.S. semiconductor workforce.

Sandeep Mittan
Director & Vice President
Amity University



Dynamic academic leader and innovator specialising in AI-driven personalized medicine research transformative powered health care platform. Leveraging clinical research experience, which belongs to larger personalized medicine efforts aims to translate research findings into clinical applications. support a diverse and rich range of research for interdisciplinary collaboration between (study sponsors, regulatory agencies, alliance partners, KOLs, etc.). Proven track record of mentoring early career investigator, best practice of clinical Operations, product management, quantitative science, and regulatory to advise on the application of internal and external Proposals of Pharmaceutical, federal funded clinical research clinical studies international knowledge-exchange initiatives and delivering industry-relevant research with real commercial impact.

AI-Enabled Biosensing and Biochip Technologies for Intelligent

The rapid development of biosensor and biochip technologies has revolutionized contemporary healthcare by facilitating the sensitive, rapid, and decentralized detection of disease biomarkers. Electrochemical and Surface-Enhanced Raman Spectroscopy (SERS) biosensors are advanced sensing platforms suitable for point-of-care diagnostics due to their high sensitivity, specificity, rapid response, and clinical potential. Electrochemical biosensors use electrical signals for measurements, while SERS biosensors offer molecular fingerprints for detecting trace biomarkers. Unfortunately, despite the promise of both biosensor platforms for broader clinical applications, implementation will be hindered by factors such as variability in signal responses, difficult-to-analyze mixed biological samples, challenges with multiplexing, and difficulties in processing complex data. Recent developments in machine learning (ML) have enabled transformative solutions by automating signal preprocessing, feature extraction, spectral analysis, pattern recognition, biomarker classification, and predictive diagnostics. Integrating machine learning algorithms with electrochemical and surface-enhanced Raman spectroscopy (SERS) biosensors improves analytical accuracy, increases noise immunity, enables simultaneous detection of multiple biomarkers, and helps clinicians make prompt clinical decisions. Furthermore, collaborative efforts involving intelligent biochips, microfluidic devices, wearable biosensors, the Internet of Medical Things (IoMT), and cloud-based analytics are driving the development of fully autonomous diagnostic systems that deliver personalized healthcare services. This research will provide a roadmap for researchers interested in applying machine learning and biosensing technologies to develop highly accurate, scalable, and clinically relevant diagnostics for precision medicine and future healthcare innovations.

Mohammadreza Shokouhimehr
Director
Florida Polytechnic University



Reza holds a Ph.D. in Chemical Engineering and serves as the Director of Chemical Processing Research at FIPR, Florida Polytechnic University. His research expertise spans nanomaterials, environmental remediation, energy, catalysis, and functional nanocomposites, with a current focus on water treatment and rare earth element recovery. Recognized among the world's top 2% of scientists, he has authored more than 300 scientific publications, received over 20,000 citations with an h-index above 80, and is an inventor on commercialized U.S. patents.

Magnetically Retrievable Nanocomposites for Environmental Remediation and Rare Earth Element Recovery

Magnetically retrievable nanocomposites offer a promising platform for sustainable environmental remediation by combining high surface reactivity with rapid magnetic separation and the potential for material reuse. This study presents the design and application of different magnetic nanocomposites for two important environmental challenges: the catalytic reduction of nitroaromatic contaminants and the recovery of rare earth elements (REEs) from waste streams. Magnetic nanocomposites with tailored surface compositions and functional groups have been developed to enhance their catalytic activity, adsorption capacity, and selective interactions with target species. The selected nanocomposites demonstrated effective catalytic reduction of nitroaromatic compounds, while functionalized magnetic coreshell nanomaterials exhibited promising adsorption and recovery of REEs, including La, Nd, Pr, Sm, and Er. Surface chemistry, nanostructure, and functionalization play critical roles in controlling contaminant conversion. Importantly, magnetic responsiveness enables the convenient separation of nanocomposites from treated media, reducing the need for separation processes. These findings highlight magnetically retrievable nanocomposites as versatile and potentially reusable materials that integrate environmental pollutant remediation with the recovery of strategically important resources from waste streams.

Parallel Session 8: Semiconductors & Sensing Applications

9:00 - 11:00am EST

Mubarak A Mujawar
Assistant Professor
Embry-Riddle Aeronautical University



Dr. Mubarak Mujawar is Assistant Professor of Engineering Physics at Embry-Riddle Aeronautical University, Daytona Beach, Florida. His current research is focused on plasma-surface interactions, plasma-material processing, nano- and microfabrication, additive manufacturing, and electrochemical sensors and systems. Prior to joining Embry-Riddle, he worked as a Research Associate Professor at Florida International University and a Research Fellow at Trinity College Dublin, Ireland. He received his Ph.D. in Plasma Science and Technology from Dublin City University, Ireland

Atmospheric Plasma-Assisted Synthesis of Gold Nanoparticles for SERS Applications

Surface-enhanced Raman spectroscopy (SERS) offers unique molecular-specific detection. However, its deployment in real-life scenarios is limited by multistep fabrication, poor nanoparticle uniformity, substrate-to-substrate variability, and reliance on vacuum-based fabrication and chemically intensive processing. This work presents atmospheric-pressure cold plasma as a versatile route for the synthesis, processing, and direct assembly of gold nanoparticles (AuNPs) into SERS-active interfaces. The work builds on our earlier demonstrations that plasma treatment can improve nanoparticle distribution, modify metal-nanoparticle morphology and optical response, and tune the electronic properties of AuNPs on sensing electrodes. It also extends our recent development of atmospheric plasma deposition of AuNPs onto porous filter paper for SERS-based detection of polystyrene particles in water. In this work, the atmospheric plasma deposition process is used to fabricate AuNP architectures on quartz, silicon, and porous paper. As-deposited AuNP films are characterized using SEM and AFM imaging, optical absorption spectroscopy, electrochemical analyses, FTIR, and Raman mapping. The observed 2-to-10 fold enhancement in SERS performance for RG6 and Cortisol is discussed by mapping the relationship between plasma-controlled morphology and localized surface-plasmon coupling. The results are discussed by emphasizing the correlations between the nanoscale junctions and clusters that create electromagnetic “hot spots.” Reproducibility is assessed across multiple printed regions and 6 independently prepared substrates by comparing Raman intensity, spectral uniformity, enhancement behavior, and spatial variation.

Rishikesh Srinivasaraghavan Govindarajan
Assistant Professor
Florida Polytechnic University



Dr. Rishikesh S. G. is an Assistant Professor of Mechanical Engineering at Florida Polytechnic University. He received his Ph.D. in Aerospace Engineering from Embry-Riddle Aeronautical University. His work focuses on advanced manufacturing, functional materials, and multifunctional microsystems, with interests spanning smart sensors, energy harvesting, MEMS, and embedded sensing. His research integrates additive manufacturing, materials development, micro/nanostructures, and characterization to create compact technologies for aerospace, structural health monitoring, biomedical, and environmental applications. He is particularly interested in leveraging novel materials and manufacturing strategies to develop integrated functionalities within next-generation engineered systems. Dr. S. G. is actively engaged in professional service through engineering and scientific societies, contributing to technical committees, conference activities, peer review, and editorial board service.

Multimodal Flexible Sensing of Strain and Temperature for Wearable Applications

Flexible sensing platforms capable of monitoring mechanical and thermal stimuli are important for wearable electronics, where deformation and temperature variations can occur simultaneously. However, cross-sensitivity between these stimuli can complicate signal interpretation and reduce measurement reliability. This work presents a multimodal flexible sensing architecture that integrates strain and temperature sensing within a single platform through strategic spatial positioning of sensing elements. Conductive thermoplastic polyurethane/carbon black (TPU/CB) sensing elements are integrated with polyimide (PI) substrates in a stacked configuration. Serpentine-patterned elements on the outer layers enable directional strain sensing, while a centrally positioned element near the neutral axis enables temperature monitoring with reduced sensitivity to mechanical deformation. Under bending, the strain sensors exhibit stable and repeatable responses over 0–2% strain, with gauge factors of −5.53 ± 0.17 in tension and 9.71 ± 0.23 in compression. The temperature sensor demonstrates a linear response from room temperature to 80 °C, with a temperature coefficient of resistance of 0.023 ± 0.003 $°C^{-1}$ after stabilization. The reduced strain influence on the central temperature-sensing layer demonstrates that spatial positioning can minimize cross-sensitivity within a flexible multimodal sensing platform. This architecture provides a practical approach for integrating mechanical and thermal sensing into flexible devices for wearable applications.

Paria Gharavi
Assistant Professor
University of Central Florida



Dr. Paria Gharavi is an Assistant Professor of Materials Science and Engineering at the University of Central Florida (UCF). Her research focuses on advanced transmission electron microscopy (TEM/STEM), in-situ and operando characterization, and structure–property relationships in functional and electronic materials. Her group employs atomic-resolution imaging, spectroscopy, 4D-STEM strain mapping, and in-situ electrothermal TEM to investigate ferroelectric thin films, interfaces, defects, and materials under extreme conditions. She received her Ph.D. in Materials Science and Engineering from UNSW Sydney and subsequently conducted postdoctoral research at the University of Pennsylvania. Her current research includes ferroelectric AlScN and HfO2-based materials, semiconductor heterostructures, and high-temperature materials.

Advanced Transmission Electron Microscopy for Nanoscale Characterization of Semiconductor Materials and Interfaces

Continued scaling and increasing structural complexity of semiconductor materials and devices require characterization techniques capable of resolving structural, chemical, and functional properties across multiple length scales. Advanced transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM) provide powerful platforms for understanding semiconductor thin films, heterostructures, interfaces, and defects at the nanoscale and atomic scale. In this presentation, we discuss the application of complementary electron microscopy techniques to investigate structure–property relationships in emerging semiconductor and functional thin-film systems. High-resolution TEM and STEM enable direct visualization of crystal structures, interfaces, extended defects, and local structural variations, while electron diffraction provides quantitative information on crystallographic orientation, phase, and texture. Energy-dispersive X-ray spectroscopy (EDS) further enables nanoscale chemical analysis and mapping across complex heterostructures and interfaces. Beyond conventional imaging and spectroscopy, four-dimensional STEM (4D-STEM) provides spatially resolved measurements of lattice distortion, strain, and crystallographic variations that are often inaccessible through conventional characterization methods. The integration of these techniques provides a multidimensional understanding of how processing conditions, composition, defects, interfaces, and local strain influence semiconductor microstructure and ultimately material performance. Emerging in-situ TEM approaches further extend these capabilities by enabling direct observation of structural evolution under external stimuli, including elevated temperature and electrical bias. Together, advanced TEM-based characterization provides critical insight into nanoscale mechanisms governing the behavior, reliability, and optimization of next-generation semiconductor materials and devices.

Poster Presenters

Note: Due to space constraints, titles are condensed for poster presentations. Full abstracts will be available at the end of the program (starting on page 73) in order of the table below.

Poster #	Name	Category	University	Abstract Title
1	Mark Fouad	High School	Pine View School	Analysis of Microplastic Concentration
2	Akshata Patne	Researcher	University of South Florida	Single-Dose Pharmacokinetics
3	Nikith John	Post-Doc	University of South Florida	ML for Early Detection of Alzheimer
4	Larry Jones & Elayaraja Kolanthai	Undergraduate & Post-Doc	University of Central Florida	Engineering Ceria Redox
5	Suguna Aishwarya Kuppa	Graduate	University of South Florida	ML Prediction of Hemolytic Toxicity
6	Stuti Dasgupta	Graduate	University of South Florida	Linolenic Acid Liposomes
7	Lucas Batista	Undergraduate	Florida Polytechnic University	Solid-State Nanopore DNA Basecalling
8	Mason Clewis	Undergraduate	University of Central Florida	Multispectral Color Barcoding
9	Alexander Gage	Graduate	University of Florida	ITO Thin Film Optimization
10	James Carter	Faculty	Florida Polytechnic University	pH-Responsive Micelles
11	Aria Khazaei	Graduate	University of Miami	Prodrug-Encapsulated Nanoparticle
12	Chanyapat Sriviroch	Graduate	University of South Florida	ML-Assisted Electrochem Biosensing
13	Gonzalo Miranda	Graduate	University of Miami	Mechanistic Study of Nanoparticle
14	Naroa Zubimendi Varela	Graduate	University of Miami	Detection of Breath Biomarkers
15	Zhidong Zhou	Post-Doc	University of Miami	Multifunctional Oral Polymeric
16	David Polkowski	Graduate	University of Miami	Dual-targeted nanoparticles approach
17	Keith Blackman	Graduate	University of Central Florida	Thermal stability & electronic structure

Poster Presenters

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Poster #	Name	Category	University	Abstract Title
18	Kaleb Sharrer	Graduate	University of South Florida	Temp Comp for Surface Acoustic
19	Abhishek Kandukuru	Graduate	University of South Florida	Neural Network for Pharmacovigilance
20	Muhammad Shahbaz Rafique	Graduate	University of South Florida	Novel Nanodiamond-Based hydrogels
21	Jason Abboud	Undergraduate	University of Florida	Tunable NanoGUMBOS for Bio Apps
22	Baby Saroja	Graduate	University of Central Florida	Polyelectrolyte-based Nanoparticle
23	Brandon Ugbesia	Graduate	University of South Florida	Thermo-Plasmonic Assembly
24	Anik Biswas	Graduate	University of Central Florida	Polymer Nanocarriers for Therapeutic Payload
25	Peter Kveton	Graduate	University of South Florida	Split-Ring Resonators for Quantum Computing
26	Sean Knapp	Graduate	University of South Florida	Quantum Coherence of Excitons
27	Minh Tran	Graduate	University of Central Florida	Effects of Ozone Aging Clould Condensation
28	Logan DiFiore	Graduate	University of South Florida	Capacitive MEMS for Hypersonic Apps
29	Rahela Dolha	Undergraduate	Embry-Riddle Aeronautical University	Morphology of Biodegradable PVA Nanofibers
30	Nayred Aguilera	Undergraduate	Florida International University	Stöber Silica Nanoparticle Synthesis
31	Akash Ashokan	Graduate	University of Miami	Blood Brain Barrier Penetrating Nanoparticle
32	Sam Meetre	Undergraduate	Florida Polytechnic University	Manufacturing for Microfluidic Mold Fabrication
33	Arka Banerjee	Post-Doc	University of Miami	Toxic Metal Removal with NanoWipes
34	Annu Joji	Graduate	University of Miami	Cyanine Fluorophores for Bioimaging

Poster Presenters

Note: Due to space constraints, titles are condensed for poster presentations. Full abstracts will be available at the end of the program (starting on page 73) in order of the table below.

Poster #	Name	Category	University	Abstract Title
35	Natalia Cisneros	Undergraduate	University of Miami	Point-of-Care Bioluminescence
36	Joshua Morris	Undergraduate	Florida Polytechnic University	Electrochemical Sensing of Microplastic
37	Oscar Sang	Undergraduate	University of Central Florida	Near-Field Optical Microscopy (SNOM)
38	Daniel Fellows	Undergraduate	Florida Polytechnic University	L-thyroxine (T4) for Thyroid Diagnostics
39	Ines Alonso	Undergraduate	Florida Polytechnic University	The q-sc-SF-EOM quantum algorithm
40	Sandeep Padakanti	Post-Doc	Florida A&M	Translating Injectable Octreotide Oral Therapy
41	Daniel Lockhart	Undergraduate	Florida Polytechnic University	Hydrocarbons Confined within Nanopores
42	Julia Franco	Undergraduate	University of Miami	Cardiolipin Delivery via Nanoparticles
43	Michael Sabo	Industry	*UNandUP LLC*	Non-Colloidal Ferrimagnetic Nanoparticles
44	Matty Sey	Graduate	Florida International University	Temozolomide-Loaded PGMD/PLGA Nanoparticles
45	Rejoan Afrin Tonoy	Graduate	University of South Florida	NiFe/Ru/FeCo Trilayers
46	Jorge David Tovar Castro	Graduate	University of Miami	A Cool Way to Protect the Brain
47	Manuel Giron	Undergraduate	Florida Polytechnic University	Biological scatters medium for Random Lasin
48	Dakota Brown	Undergraduate	University of South Florida	Shell-Thickness Dependence Magnetic Hyperthermia
49	Bipin Paudel	Graduate	Florida International University	Core-Shell Electrodes for Enhanced
50	Chhatra Bastola	Graduate	Florida International University	Plasmon-Assisted Electrochemical CO_2

Poster Presenters

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Poster #	Name	Category	University	Abstract Title
51	Jayden Craft	Graduate	University of Central Florida	Transfer-Matrix Modeling of Graphene
52	Marissa Alcala	Graduate	Florida State University	Blue Fluorescing N-Heterocyclic
53	Ayomipo Ojo	Graduate	University of South Florida	Epitaxial Mn4N Thin Films
54	Alejandra Planells Devesa	Graduate	University of Miami	Acute Kidney Injury from Exhaled Breath
55	Rebecca Robinson	Undergraduate	Florida Polytechnic University	Repeatable Laser Emission Spectra
56	Elnaz Jaberolansar	Graduate	University of South Florida	Synthesis and In Vitro Evaluation
57	Vimukthi D.G. Arachchige	Graduate	University of South Florida	Dynamic Spin-Wave Characterization
58	Marium Sultana	Graduate	Florida International University	P22 Nanocage Encapsulation
59	Abraham Campos	Graduate	Florida International University	Deep Learning for Physics-Informed Nanopore
60	Md Hossain	Graduate	Florida International University	Aggregation Dynamics Using Nanopore Sensing
61	Shah Qasim Jan	Graduate	University of South Florida	Light and Magnetism in One
62	Balavardhan Reddy Apur	Graduate	University of South Florida	RGD-Modified PLGA Nanoparticles
63	Vishnu Teja Vattipalli	Graduate	University of South Florida	Corneal Targeted Polycaprolactone Nanoparticles
64	Logan Yang	Undergraduate	University of Central Florida	Interaction of Nano Plastics Particles
65	Patrick Foti	Undergraduate	University of South Florida	Toward Nanoscale Magnetofluorescence
66	James Tedder	Undergraduate	Florida Polytechnic University	Femtosecond laser deposition

Poster Abstracts

Comparative Analysis of Microplastic Concentration and Composition in Public Park Ponds and Stormwater-Influenced Natural Waterways

Mark Fouad, Elizabeth Loyer

This study investigates the effects of storm drainage systems on natural waterways and compares the concentration and composition of microplastics in public park ponds and natural waterways containing storm drainage runoff. Understanding the difference between the sources of microplastic pollution is necessary for further development that can help improve the current state of the aquatic environment and work towards better management and pollution mitigation to improve the aquatic environments. The water samples that were obtained came from three public park ponds and three natural waterways that contained storm drainage runoff in southern Florida through a means of random generation. There was a density separation process that took place after, followed by hydrogen peroxide digestion and Nile red staining. The samples were then examined under 40× magnification and confirmed under 100× magnification for particles between 1mm and 5mm in size, where they were then classified and identified as microplastics, microfibers, etc. The results that were obtained from this data were plugged into a Mann–Whitney U test, and this test provided the result that there was no significant difference and that the outcome for this observational study was due to chance. These findings suggest that within the 1mm to 5mm range there was no significant difference. For future researchers, an enlargement of detection from 1nm to 5mm could enhance the project and allow for better outcomes.

Keywords: microplastics, stormwater runoff, freshwater ponds, urban waterways, Nile red staining, density separation, Mann–Whitney U test,

Single-Dose Pharmacokinetics and Renal Biodistribution of Col4α3-Targeted Prednisolone Sodium Phosphate in Liposomal Nanoparticles in Normal and Lupus-Prone Mice

Akshata Patne, Shreyasi Majumdar, Ruisheng Liu, Subhra Mohapatra, Shyam Mohapatra

Background: Collagen IV α3 (Col4α3), a structural component of the glomerular basement membrane, is accessible from the fenestrated glomerular capillary interface and represents a potential address for renal nanocarrier delivery. Prior efficacy and imaging studies established renal benefit and glomerular localization of a Col4α3-binding peptide liposome, but its pharmacokinetic basis remained unresolved.
Methods: Prednisolone sodium phosphate (PSP) was administered as free drug, a non-targeted mPEG-DSPE liposome, or a Col4α3-targeted liposome at 0.3 mg/kg by a single intravenous bolus to lupus-prone and normal mice. Serum and kidney were collected at 1, 6, and 12 h (n = 3 per formulation-time cell). Intact PSP was quantified by LC-MS/MS. Serum pharmacokinetics were evaluated by non-compartmental analysis. Renal selectivity was defined prospectively by the kidney:serum AUC0-12 ratio and expressed relative to free PSP.
Results: In lupus-prone mice, serum half-life was 3.02 ± 0.33 h for free PSP, 6.31 ± 0.43 h for mPEG-DSPE, and 18.94 ± 1.01 h for Col4α3-targeted PSP. Corresponding serum AUC0-12 values were 26,704 ± 2,725, 40,866 ± 4,275, and 59,254 ± 3,785 ng·h/mL. Kidney AUC0-12 values were 2,613, 3,835, and 10,050 ng·h/g, respectively. The non-targeted carrier increased kidney exposure to 147% of free PSP but did not improve targeting efficiency (94.8% of free). In contrast, Col4α3 targeting increased kidney exposure to 385% and targeting efficiency to 170.7% of free. The targeted formulation displayed delayed renal Tmax at 6 h and sustained kidney concentrations through 12 h. The same rank order was observed in normal mice.
Conclusions: Both liposomal formulations increased systemic and renal PSP exposure, but only Col4α3 conjugation increased kidney exposure relative to systemic exposure. These findings separate carrier-mediated exposure from ligand-mediated selectivity and show that tissue AUC alone is insufficient evidence of targeting. The study supports Col4α3 targeting as a strategy to redistribute PSP exposure toward the kidney, while additional biodistribution, pharmacodynamic, and bioanalytical validation are required before claims of systemic sparing can be made.
Keywords: collagen IV α3; glomerular basement membrane; lupus nephritis; liposome; prednisolone sodium phosphate; pharmacokinetics; renal targeting; LC-MS/MS

Tauscan-AI: Machine Learning for Early Detection of Alzheimer's Disease via Tau Biomarkers

Nikith John, Subhra Mohapatra, Shyam Mohapatra

Background: Blood-based biomarkers could enable non-invasive Alzheimer's disease (AD) screening, but many machine-learning classifiers report high accuracy while including cognitive test scores that are themselves part of the clinical diagnosis obscuring how much signal comes from biomarkers alone. We developed a biomarker-only classifier and quantified this effect.
Methods: We assembled plasma p-tau217, p-tau181, total tau, amyloid-beta 42/40 ratio, GFAP, neurofilament light, and cortisol, with APOE4 genotype, age, and education data from the ADNI database. Values from multiple assay platforms were standardized within-source before merging, and all preprocessing statistics were fit on training data only to prevent leakage. An ensemble (logistic regression, random forest, gradient boosting, XGBoost) was evaluated on held-out data for AD-versus-cognitively-normal (CN) discrimination.
Results: The biomarker-only model achieved an AUC of 0.933 for AD versus CN (sensitivity 77%, specificity 89%, NPV 0.92; 140 CN and 48 AD in the test set), using no cognitive testing. The strongest predictors were the p-tau217/amyloid and p-tau181/amyloid ratios and the amyloid-beta 42/40 ratio, consistent with AD neurobiology. Adding MMSE and ADAS-Cog13 raised three-class AUC to 0.95, but feature-importance analysis showed this gain was driven almost entirely by the cognitive scores, which contribute directly to the diagnostic labels, rather than by biomarkers.
Conclusions: Plasma biomarkers alone discriminate AD from CN at 0.93 AUC, matching published blood-based classifiers. Accuracy gains from adding cognitive scores largely reflect reconstruction of the diagnostic criteria, and should be reported transparently.

Key words: Alzheimer's disease, plasma biomarkers, p-tau217, machine learning, diagnostic circularity

Engineering Ceria Redox states via Rare Earth Gadolinium Doping for biomedical application

Larry Jones, Elayaraja Kolanthai, and Sudipta Seal

Cerium oxide exhibits reversible Ce^{3+}/Ce^{4+} redox cycling, enabling its nanoparticles to donate or accept electrons and mimic endogenous antioxidant enzymes. However, variability in redox state distribution can limit their biological performance. Doping cerium oxide is an effective strategy to modulate its redox behavior and enhance oxygen vacancy formation. When Gd^{3+} substitutes for Ce^{4+} within the ceria lattice, charge compensation mechanisms generate oxygen vacancies that influence catalytic, redox, and enzyme mimetic activity. In this study, cerium oxide nanoparticles were synthesized at 85 °C for 6 hr. using a hydrogen peroxide–driven hydrolysis method. A 0.1 M solution of gadolinium (III) nitrate hexahydrate was added to two different percussor such as cerium (III) nitrate hexahydrate and cerium (IV) nitrate hexahydrate prior to peroxide addition. After reaction, the resulting nanoparticles were subjected to dialysis, and the un-dialyzed and dialyzed formulations were designated GdCNP3$^+$, GdCNP4$^+$, dia GdCNP3$^+$, and dia GdCNP4$^+$. All nanoparticle formulations underwent comprehensive physicochemical characterization. UV–Vis spectroscopy confirmed cerium oxide formation and revealed redox state variations through peak shifts and intensity changes. Particle size and zeta potential measurements showed lower values for GdCNP4$^+$ compared with GdCNP3$^+$ particles. XPS analysis demonstrated that Gd doped CNPs contained a higher fraction of Ce^{3+} relative to undoped CNPs. Functionally, GdCNP3$^+$ exhibited greater superoxide scavenging activity than GdCNP4$^+$. Overall, the Gd doping into CNPs strongly influenced the physicochemical properties of Gd doped CNPs. Additional biological studies are under process.

Machine Learning Prediction of Hemolytic Toxicity to Guide Safer Antimicrobial Peptide Nanotherapeutic Design

Suguna Aishwarya Kuppa, Dr.Feng Cheng

Antimicrobial peptides (AMPs) are a promising class of therapeutics, but their clinical translation is often limited by hemolytic toxicity, the tendency to damage red blood cells. To address this, nanomedicine approaches increasingly encapsulate AMPs within liposomal or polymeric nanocarriers to shield healthy cells from direct peptide contact, control release, and improve therapeutic selectivity; however, selecting which peptide candidates are worth carrying forward into such nanotherapeutic formulation remains largely guided by slow, resource-intensive experimental hemolysis assays. In this study, we developed a machine learning pipeline to predict hemolytic toxicity directly from peptide sequence, intended as an early triage tool for antimicrobial peptide nanotherapeutic design. The peptides were encoded using ESM2 (Evolutionary Scale Modeling 2) protein language model embeddings (8-million-parameter model, mean-pooled) and classified using a LightGBM (Light Gradient Boosting Machine) model, with performance evaluated via 5-fold cross-validation and an independent external validation dataset (HemoPI-1). Alanine-scanning mutagenesis was performed to identify residues most influential to predicted toxicity. The model achieved a held-out test ROC-AUC of 0.867, 5-fold cross-validation AUC of 0.846 ± 0.031, and external validation AUC of 0.827, indicating strong generalization. Aromatic (W/F/Y) and cationic (K/R/H) residues contributed significantly more to predicted hemolytic activity than other residues ($p < 0.001$), consistent with known membrane-disruption mechanisms, while residue position showed no significant effect ($p = 0.86$). These findings support protein language model-based toxicity prediction as a scalable computational tool for prioritizing safer peptide candidates before committing them to nanocarrier-based antimicrobial peptide delivery system development.

Linolenic Acid-Encapsulated Liposomes Containing Nitazoxanide and Acetate Reduce SARS-CoV-2 and RSV Infection

Stuti Dasgupta, Shyam Mohapatra, Subhra Mohapatra

Objective: To evaluate the antiviral efficacy of linolenic acid-encapsulated liposomal nanoparticles (LNPs) co-loaded with nitazoxanide (NTZ) and acetate, alone and in combination, against respiratory syncytial virus (RSV) and severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection.
Background: RSV and SARS-CoV-2 remain major causes of respiratory morbidity and mortality worldwide, particularly among vulnerable populations, and both pathogens have limited treatment options, underscoring an unmet need for broad-spectrum antivirals with improved efficacy and reduced toxicity. Short-chain fatty acids and bioactive lipids exhibit intrinsic antiviral activity, motivating development of lipid-based nanoparticle formulations capable of targeting multiple respiratory pathogens simultaneously. This study tested whether encapsulating NTZ and acetate within linolenic acid-containing LNPs enhances antiviral potency against RSV and SARS-CoV-2 relative to free drug.
Methods: RSV-infected Vero and HEp-2 cells were treated with NTZ and acetate as free drugs or encapsulated in linolenic acid LNPs, individually and in combination, and infection was quantified by red fluorescent protein (RFP)/4′,6-diamidino-2-phenylindole (DAPI) immunofluorescence imaging and integrated fluorescence density analysis. The same formulations were evaluated in SARS-CoV-2-infected Vero and Calu-3-ACE2 cells to assess broad-spectrum antiviral activity across viral species and cell line systems.
Results: LNP-encapsulated NTZ and acetate showed significantly enhanced antiviral activity compared to free drug counterparts against RSV, with combination LNP formulations producing synergistic inhibition of viral replication and reduced cellular pathology; the dual-drug LNP combination achieved the greatest reduction in viral infection burden across both cell lines. In SARS-CoV-2-infected Vero and Calu-3-ACE2 cells, the same linolenic acid LNP formulations produced comparable dose-dependent, synergistic antiviral effects, with combination treatment significantly reducing viral replication relative to untreated and free-drug controls.
Conclusion: Linolenic acid-encapsulated LNPs co-loaded with NTZ and acetate provide enhanced, broad-spectrum antiviral activity against RSV and SARS-CoV-2 across multiple cell line systems, supporting further optimization, mechanistic study, and clinical translation of lipid-based antiviral nanoparticles for respiratory viral infections.

Towards Self-Supervised Pretraining for Solid-State Nanopore DNA Basecalling

Lucas Batista, Ajeet Kaushik

Nanopore sequencing determines DNA sequence by threading a single molecule through a nanoscale pore and measuring the resulting disruption to an ionic current. Biological nanopores use a motor protein to ratchet DNA through at a controlled, slow rate, producing a clean, well-sampled signal. Solid-state nanopores, fabricated from engineered inorganic membranes using standard semiconductor manufacturing, offer a cheaper, mass-manufacturable alternative, but they lack this motor-protein control, so DNA translocates faster and less predictably, producing a noisier signal that has largely limited solid-state platforms to coarse molecule classification rather than full base-level sequencing. Deep learning basecallers for biological nanopores require large labeled datasets, which are costly to produce. Recent work, including BGI's CycloneSEQ, addressed this by adapting wav2vec2.0-style self-supervised pretraining, learning general signal structure from abundant unlabeled current traces before fine-tuning a decoder on a small labeled set, and achieving accurate basecalling with reduced labeling cost. Separately, self-supervised pretraining has been validated on real solid-state nanopore signal, but only for coarse classification tasks such as single-molecule protein identification, not full DNA basecalling. No published work has tested whether this proven self-supervised approach transfers to solid-state nanopore DNA basecalling specifically. We propose evaluating this transfer directly by pretraining a wav2vec2.0-style encoder-quantizer-transformer on unlabeled solid-state nanopore current traces, then fine-tuning a lightweight decoder on limited labeled data, and systematically testing performance against the three factors that most plausibly break the technique, namely faster and less-controlled translocation speed, elevated signal noise, and device-to-device fabrication variability that is absent in biological pores. If self-supervised pretraining proves robust to these solid-state-specific conditions, it would substantially lower the labeled-data barrier currently limiting solid-state nanopore sequencing, offering a path toward cheaper, more scalable, protein-free DNA sequencing hardware.

Multispectral Color Barcoding for Portable Biosensing

Mason Clewis, Jaden Clewis, Mahdi Soudil, Donovan Roman, Aritra Biswas, Debashis Chanda

Smartphone-readable structural color biosensors offer a low-cost and portable approach to biochemical detection, but measurements from a single sensor can be affected by nonspecific interactions, changes in illumination, and differences between imaging devices. Here, we introduce a retrospective multispectral barcoding strategy for more reliable detection of immunoglobulin G (IgG) by combining the responses of sensors with different structural colors. Each sensor consists of a chromium mirror, a thin aluminum oxide spacer, and a surface layer of aluminum nanoparticles. Adjusting the thickness of the oxide and nanoparticle layers changes how the sensor interacts with light, producing distinct colors and different responses to molecular binding. Following analyte exposure, the sensors were measured using an iPhone 14, a digital single-lens reflex (DSLR) camera, and a spectrometer. The recorded color information was converted into CIELAB color space, where ΔE^*ab was used to quantify the overall color shift relative to each sensor's baseline. Among 19 sensor designs, the geometry containing a 20-nm oxide spacer and 5-nm aluminum nanoparticle layer performed best across both iPhone and DSLR measurements, showing strong correlations between IgG concentration and color change ($r = 0.979$ and 0.995, respectively). In retrospective testing, the combined barcode correctly identified 75.9% of positive cases and 98.2% of negative controls, corresponding to 87.0% balanced accuracy. Pairing the 20-nm oxide/5-nm nanoparticle and 20-nm oxide/7-nm nanoparticle designs as primary and confirmatory detection channels produced matching classifications in 75.2% of cases. When the channels agreed, classification accuracy reached 95.0%. Together, these findings reveal limitations unique to each measurement method and show that combining multiple structural colors can improve detection reliability beyond single-color sensing, supporting the development of reliable optical biosensing.

ITO Thin Film Optimization

Alexander Gage, Marshall Reich, Hao Wang, Volker Sorger

Indium Tin Oxide (ITO) is a specific material within the class of materials of Transparent Conductive Oxides (TCOs). ITO is commonly used in electronic and aerospace components such as Photovoltaics, Displays, and Aircraft Windows. ITO is used for a wide range of applications due to its superior Electronics properties, having lower resistivity compared to other TCOs. However, while deposition and post processing conditions, such as optimizing oxygen content, annealing and substrate temperature can optimize the resistivity down to 1E-4 ohm-cm, reducing resistivity comes at the cost of the Optical Loss, given that the transparency of ITO is one of the main properties of value, this is unacceptable. Therefore, work to assess the tradeoff between improving conductivity while maintaining optical transparency, and assessing if there are any methods to improve these variables are needed. Our work examines the effect of inputs in fabrication, including DC sputtering, substrate temperature, atmospheric oxygen content in the fabrication, and post process annealing temperatures. Samples were tested on hall effect to measure resistivity, carrier density and mobility, and measured with ellipsometry ranging in wavelength from 240 to 1680 nm to determine the optical indices of the materials. Our work has identified definitive patterns in ITO formation and post processing that can be used as a guideline for future work in fabricating ITO films with desired properties. We have identified that annealing plays just as much if not a greater role in ITO formation and property development as initial conditions, with ITO deposited under vastly different conditions, including oxygen percentage, and deposition power approaching the same resistivity and loss under annealing. By varying power, oxygen percentage and annealing temperature and time, we were able to create ITO that has a lower resistivity and optical loss combination compared to existing samples.

pH-Responsive Micelles for Zika Ribavirin Delivery

Maria R. Blahove, Julissa Rodriguez, Asa Waterman, Johnathan A. Saviskas, Briany G. Santos-Villalobos, Maxwell A. Wallace, Janae A. Culmer, **James R. Carter**

Zika virus (ZIKV) presents a severe global health threat due to its vertical transmission risk and neurological complications, yet no targeted antivirals exist. The broad-spectrum analog ribavirin is potent but limited by dose-dependent toxicity and poor systemic bioavailability. Because ZIKV utilizes receptor-mediated endocytosis for cell entry, targeting the acidic endosomal environment offers a precise pathway for localized drug delivery. This study evaluated two biocompatible nanocarriers: an ABA triblock polymer, mPEG-PCL-mPEG (methoxy poly(ethylene glycol)-poly(ε-caprolactone- methoxy poly(ethylene glycol) and an AB diblock polymer (mPEG-PCL). Synthesized via ring-opening polymerization of ε-caprolactone and validated by FTIR/^{1}H NMR, both systems self-assembled into micellar nanoparticles (MNPs). Ribavirin was encapsulated via sonication through hydrophilic interfacial interactions. Triblock MNPs exhibited a mean diameter of 63.4 nm with 62.3% encapsulation efficiency (EE), while diblock MNPs measured 34.9 nm with 87.1% EE. Both maintained a near-neutral surface charge (–3.3 to –3.7 mV) to evade immune clearance. In vitro profiles showed accelerated, pH-dependent release under simulated endosomal conditions (~88% at pH 5.5 vs. ~20% at pH 7.4). In ZIKV-infected choriocarcinoma (JEG-3) cells, MNPs dramatically enhanced antiviral potency, shifting the effective dose from micromolar to nanomolar thresholds. Triblock and diblock formulations achieved half-maximal effective concentrations (EC_{50}) of 0.15 nM and 0.20 nM, respectively, reducing the required drug volume by up to 90%. Consequently, targeted delivery eliminated severe cytotoxicity, preserving 80% to 95% host cell viability. Intracellular uptake and complete viral suppression were confirmed via laser scanning confocal microscopy and the absence of detectable vRNA through RT-qPCR (quantitative reverse transcription polymerase chain reaction). Exploiting endosomal acidification pathways with biodegradable copolymer matrices significantly expands the therapeutic index of hydrophilic antivirals. These platforms offer a scalable, highly efficient nanomedicine framework to combat emerging viral pathogens.

Evaluation of a Cisplatin Prodrug-Encapsulated Nanoparticle Platform for Prostate Cancer Therapy: Analysis of Tumor Response and Apoptosis

Aria Khazaei, Akash Ashokan, Shrita Sarkar, and Shanta Dhar

Prostate cancer, to this day, includes a high mortality rate among adult men, with treatment options being limited due to systemic toxicity and drug resistance. New nanoparticle-based delivery systems show promising signs and new ways to improve the efficiency of therapy by having an enhanced delivery system that reduces non-targeted symptoms and effects while directly targeting the cancer cells. The purpose of such a project is to evaluate a cisplatin prodrug-encapsulated nanoparticle platform as a new potential way to look at therapeutic approaches for prostate cancer and to find the effects on the tumor and its microenvironment.

Previously, we reported that a prostate cancer-targeting cisplatin prodrug-encapsulated nanoparticle platform reduced tumor progression; the current study uses an immune-competent mouse model to clarify the influence the nanoparticle has within the tumor microenvironment. This specific study evaluates the effects of the nanoparticle platform on myeloid-derived suppressor cells (MDSCs) and their metabolic activity to analyze how modulating such immunosuppressive cells can improve therapeutic efficacy and enhance the anti-tumor immune response. We utilized different cellular and molecular techniques such as immunofluorescence to investigate cell apoptosis, immune cell interactions, metabolic regulation, treatment resistance, and immune cell interactions. Such a comprehensive approach will aim to offer a new and better understanding of how nanoparticle-based therapies influence tumor biology and support the development of more effective targeted cancer treatments.

Such research helps to vastly coordinate our understanding of nanoparticle-targeted delivery and its effects on the biology of prostate cancer, which would contribute to less toxic and more effective therapeutic strategies. Future findings from this project will potentially aim to support advances in nanoparticle-based cancer treatments for patients with advanced prostate cancer and improve their outcomes.

Machine Learning-Assisted Electrochemical Biosensing for Classification of SLPI Functional States

Chanyapat Sriviroch, Asif Hasan Ridoy, A K M Abirul Haque, Muhammad Shahbaz Rafique, Ashok Kumar, Ali Ashraf

Electrochemical biosensors provide a promising approach for biomarker detection; however, conventional analysis often relies on individual electrochemical parameters that may not fully capture the multidimensional information contained within impedance measurements. Secretory leukocyte protease inhibitor (SLPI) is a wound-associated biomarker that can be used for wound monitoring. SLPI functional states were compared using machine learning (ML) to analyze an electrochemical impedance spectroscopy (EIS) signal acquired from a graphene-based screen-printed electrode (SPE) biosensor to determine whether impedance signal properties could differentiate SLPI functional states. Charge-transfer resistance, double-layer capacitance, diffusion coefficients and impedance magnitude and phase were extracted from the EIS data and normalized. Principal component analysis (PCA) was used to reduce the dimensionality of the data. Random Forest classification was then used to class the three states; Active SLPI, Inactive SLPI and Cell Media conditions. PCA clustered these three conditions well regardless of trial, which demonstrated the reproducibility of the features extracted. The Random Forest classifier achieved 5-fold cross-validation accuracy of 0.967 ± 0.021, with a macro-averaged area under the curve (AUC) score of 0.999. Leave-One-Trial-Out cross-validation resulted in similar 0.967 ± 0.027 accuracy and 0.998 AUC, confirming the results that show that ML-helped EIS can be used to identify reproducible electrochemical signatures corresponding to the functional states of SLPI. These results suggest that ML-assisted EIS analysis can distinguish reproducible electrochemical signatures corresponding to SLPI functional states, indicating the potential for data-driven biosensing to identify wound biomarkers.

This research is based upon work supported by the National Science Foundation NRT under Grant Number 2347019.

Mechanistic Study of Nanoparticle Entry Through The Blood Brain Barrier And Mitochondrial Dynamics

G. Miranda, A. Ashokana,, and S. Dhar

Brain-related disorders, including glioblastoma multiforme, Parkinson's disease, and Alzheimer's disease, have become increasingly prevalent over the past two decades. Despite advances in treatment, the effective delivery of therapeutics to the brain remains a major challenge due to the highly selective nature of the blood-brain barrier (BBB), restricting entry to most drugs into the central nervous system. To address this challenge, our laboratory has developed a BBB-crossing nanoplatform designed to enhance the delivery of therapeutic agents to the brain without causing BBB disruption or brain damage. Mitochondria-targeted nanoparticles functionalized with triphenyl phosphonium (TPP) cations, creating a delocalized positive charge, have been shown to accumulate near and within the mitochondria by exploiting the organelle's negative membrane potential. This is well established; however, it remains unknown how mitochondrial morphology modulates nanoparticle uptake. We hypothesize that the nanoparticles enter the mitochondria during mitochondrial fusion and fission. Mitochondria continuously maintains its homeostasis through fission and fusion events. The fusion events can allow for mitochondrial gene transfer to optimize mitochondrial metabolic regulation. The fission allows for the separation into fully functioning closed membrane individual mitochondria. Utilizing a species of knock down (KO) cells to investigate the role of mitochondrial fission and fusion we can further examine nanoparticle entry into the mitochondria. Utilizing nanoparticles loaded with quantum dots we can analyze how fission and fusion are affecting nanoparticle uptake. Observing notable differences in cycle regulation, site of accumulation, and retention time. By developing OPA1 knocked out patient derived glioblastoma cells (GSC1R) and DRP1 knocked out GSC1R cells, which code for fusion and fission respectively, we will look in vitro at the localization of cells with quantum dot loaded mitochondria targeted nanoparticles within these KO GSC1R cells to understand the mitochondrial dynamics of these cancer cells. This work is supported by the University of Miami Sylvester Comprehensive Cancer Center Cancer Innovation Grant.

Detection of Breath Biomarkers For Prediction of Epileptic Seizures

Mendel Coen, Jackson Francis, Jesse Ramos, Naroa Zubimendi Varela, Dr. S. Daunert, Dr. E. Dikici

Epilepsy is a neurological disorder affecting more than sixty-five million people worldwide. Epileptic seizures can cause permanent brain damage, lead to injury due to falling or car accidents, and, in some cases, cause sudden death. Generally, epileptic seizures present without warning. Recent studies have revealed the presence of specific volatile organic compounds (VOCs) found only in the breath and sweat of epileptic patients during the preictal and ictal phases, which suggests that these VOCs are potential biomarkers for epileptic seizures. Canines trained to detect the scent of the VOC biomarker have predicted epileptic seizures accurately and more than an hour in advance, showing that accurate detection of the biomarker in real time can lead to accurate seizure predictions. Gas chromatography – mass spectroscopy (GC-MS) is an accurate and effective way to detect specific VOCs, but it is very expensive and can only be used in a lab setting. Some affordable methods for detecting VOCs “electronically” include colorimetric sensor arrays, metal-oxide/solid-state sensors, and electrochemical sensors. In this paper, we propose a method of detecting VOC biomarker vapors (like those found in the breath of epileptic patients), using a screen-printed Metrohm-Dropsen 110 electrochemical sensor modified with PEDOT:PSS, b-CD and functional additives. We have successfully selectively detected small amounts of the VOC biomarker vapor and have developed a wireless electrochemical station that could be incorporated into a wearable device.

Multifunctional Oral Polymeric Nanoparticles for Treatment of Prostate Cancer

Z. Zhoua, A. Ashokana, S. Dhar

Prostate cancer is one of the most frequently diagnosed cancers among men in Florida and the second leading cause of cancer death in the state. Advanced prostate cancer often requires repeated intravenous infusions at specialized centers, which can create additional barriers for patients in rural areas. Oral delivery of cancer therapeutics is an attractive strategy that can improve patient convenience while reducing the burden of invasive administrations. Here, we are developing a low-cost drug-loaded nanoformulation that aims to provide oral bioavailability and cancer targeting. Ivermectin (IVM), an FDA-approved antiparasitic drug, is loaded into biodegradable nanoparticles functionalized with Fc-containing moieties. These moieties exploit neonatal Fc receptor (FcRn)-mediated transcytosis for intestinal absorption. Additionally, these nanoparticles are further modified with glutamate-urea (GLU) ligands to target prostate-specific membrane antigen (PSMA) expressed on prostate cancer cells. The resulting nanoparticles (Fc-GLU-IVM-NPs) will be optimized and characterized for parameters including size, zeta potential, drug loading and release, ligand conjugation, and stability under simulated gastric and intestinal conditions. Following the formulation optimization, intestinal transport, oral pharmacokinetics, biodistribution, PSMA-mediated tumor accumulation, and therapeutic efficacy will be evaluated in preclinical models of castration-resistant prostate cancer. This dual-function system combines intestinal absorption with tumor-specific targeting. By combining oral bioavailability, active tumor targeting, and repurposing of an FDA-approved drug within a single nanoplatform, this system may provide a noninvasive and scalable approach to advanced prostate cancer treatment.

Acknowledgements: This work is supported by Casey DeSantis Florida Cancer Innovation Grant (26C43).

Dual-targeted nanoparticles-based approach exploring the cancer-atherosclerosis axis to address cancer proliferation and enhance chemotherapeutic outcomes

David Polkowski, Akash Ashokan, Fiorella Yantani Coto, Shrita Sarkar, Shanta Dhar

Atherosclerosis involves plaque buildup caused by foam cells, which can thin and rupture the arterial wall. This disrupts cholesterol homeostasis and impairs reverse cholesterol transport (RCT), leading to processes that promote coronary artery disease (CAD). Increased lipid availability in this context can be exploited by cancer cells. Prostate and breast cancers are examples of aggressive cancers that frequently turn to fatty acid oxidation (FAO) to facilitate their quick growth. Drug resistance further enhances this metabolic reprogramming. Atherosclerosis contributes to this shift by creating a lipid-rich environment conducive to FAO. Overall providing an energy rich environment for advanced cancers to increase their spread. To address this, we developed a dual targeted lipid nanoparticle designed to reduce lipid accumulation and oxidative stress within atherosclerotic tissue. Prostate and breast cancers reprogram energy metabolism toward FAO. In parallel, atherosclerosis reduces RCT and increases lipid substrate availability. This metabolic convergence may heighten cancer risk in patients with atherosclerosis. We propose an oral administration of dual targeted lipid nanoparticles, which targets FAO substrates and oxidative stress, could enhance therapeutic outcomes. Patients with existing conditions may benefit from this dual-targeted NP due to reduced toxicity associated with chemotherapeutics. This approach offers a novel therapeutic strategy focused on FAO inhibition in metabolically vulnerable populations.

Thermal stability and electronic structure of Pt clusters on TiO2(100) surfaces

Keith Blackman, Sebastian Chimino, Eric Segrest, Mihai E. Vaida

Platinum (Pt) is widely used in heterogeneous catalysis, but its scarcity and cost motivate strategies that maximize Pt utilization through highly dispersed atoms and clusters. Their stability under catalytic conditions depends strongly on interactions with the supporting oxide. Here, we investigate the electronic structure and thermal stability of Pt on oxidized and reduced TiO2(100) surfaces. Extreme ultraviolet photoemission spectroscopy (XUV-PES) characterizes the electronic structure of Pt on oxidized and reduced TiO2 and amorphous SiOx, as well as its evolution with Pt cluster size on fully oxidized TiO2(100). Complementary CO temperature programmed desorption (CO-TPD) probes the thermal evolution of Pt adsorption sites using two consecutive measurements on the same Pt/TiO2 preparation. Distinct thermal behavior is observed on oxidized and reduced TiO2. On fully oxidized TiO2(100), consecutive TPD measurements show a redistribution of CO desorption toward lower temperatures, consistent with thermally induced Pt restructuring and sintering. On reduced TiO2, the high-temperature CO-desorption feature is selectively suppressed during the second TPD while the lower-temperature component remains largely unchanged. The high-temperature feature is recovered following O2 reoxidation, indicating a reversible modification of the Pt–TiO2 interface consistent with strong metal–support interactions. XUV-PES further reveals a coverage-dependent evolution of Pt electronic structure, with occupied states emerging at the Fermi level above ~0.14 ML Pt coverage, indicating the onset of metallic character as Pt–Pt interactions increase. Together, these results demonstrate that both Pt cluster size and the chemical state of the oxide support strongly influence Pt electronic structure and thermal stability. The contrasting thermal behavior of Pt on oxidized and reduced TiO2 highlights the competition between Pt–Pt aggregation and Pt–support interactions and provides insight into strategies for controlling the thermal stability, dispersion, and electronic properties of Pt clusters for catalytic applications.

Temperature Compensation for Surface Acoustic Wave Nebulization Devices

Kaleb Sharrer, Jacob Rowe, Mojgan Jafaripirouz, Theresa Evans-Nguyen, and Venkat R. Bhethanabotla

Surface acoustic wave nebulization (SAWN) utilizes Rayleigh-type waves to convert liquid samples into a fine stream of particles. Owing to its low sample volume requirements and ability to efficiently aerosolize liquids, SAWN has attracted increasing interest in a variety of particle-generation applications. However, stable, continuous operation is required to maintain consistent particle production and reliable performance. Achieving such reliability is essential for the maturation of SAWN into a practical and widely adopted technology. Despite their promise, SAWN devices are susceptible to self-heating during operation, which induces resonant-frequency shifts and compromises performance stability. In this work, this challenge is addressed through silicon dioxide temperature-compensation thin films deposited across the interdigital transducer and delay-line regions of 128° YX-cut lithium niobate SAWN devices. Beyond mitigating thermally driven resonant-frequency variation, the silicon dioxide coating imparts durable superhydrophilic surface characteristics that improve liquid spreading on the device. This enhanced wettability facilitates more uniform liquid delivery to the active SAW region, resulting in improved nebulization consistency. The performance of these temperature-compensated SAWN (TC-SAWN) devices is evaluated to assess their ability to reduce thermal instability and support reliable high-throughput operation, demonstrating a promising strategy for improving SAWN stability and performance.

Designing a Predictive and Generative Neural Network for Pharmacovigilance: Learning from Systematic Case Studies of Cardiovascular Adverse Events in Antiglaucoma Therapy

Abhishek Kandukuru, Sur Patel, Dr. Sutariya Dr. Nkembo Dr. Gupta Dr. Sharma

Surface acoustic wave nebulization (SAWN) utilizes Rayleigh-type waves to convert liquid samples into a fine stream of particles. Owing to its low sample volume requirements and ability to efficiently aerosolize liquids, SAWN has attracted increasing interest in a variety of particle-generation applications. However, stable, continuous operation is required to maintain consistent particle production and reliable performance. Achieving such reliability is essential for the maturation of SAWN into a practical and widely adopted technology. Despite their promise, SAWN devices are susceptible to self-heating during operation, which induces resonant-frequency shifts and compromises performance stability. In this work, this challenge is addressed through silicon dioxide temperature-compensation thin films deposited across the interdigital transducer and delay-line regions of 128° YX-cut lithium niobate SAWN devices. Beyond mitigating thermally driven resonant-frequency variation, the silicon dioxide coating imparts durable superhydrophilic surface characteristics that improve liquid spreading on the device. This enhanced wettability facilitates more uniform liquid delivery to the active SAW region, resulting in improved nebulization consistency. The performance of these temperature-compensated SAWN (TC-SAWN) devices is evaluated to assess their ability to reduce thermal instability and support reliable high-throughput operation, demonstrating a promising strategy for improving SAWN stability and performance.

Novel Nanodiamond-Based hydrogels for Targeted Drug Delivery to the Retinal Pigment Epithelium

Muhammad Shahbaz Rafique, Sundaramoorthy Gopi, Ali Ashraf, Manas Biswal, Ashok Kumar

Effective drug delivery to the retinal pigment epithelium remains a significant clinical challenge due to ocular barriers, rapid drug clearance, and limited bioavailability associated with conventional therapies. Nanodiamonds offer distinct advantages, including high surface area, tunable surface chemistry, excellent biocompatibility, and long-term stability, making them promising candidates for ocular drug delivery. However, their potential for RPE-specific targeting and controlled drug release has not been fully explored. This research is therefore warranted to systematically optimize nanodiamond-based delivery systems and advance precision therapeutic strategies for retinal diseases. To synthesize the nanodiamond-polymer hydrogel, GelMA hydrogel was used as the polymer matrix and was mixed with the ND. After the synthesis mechanical and morphological properties of the hydrogel were characterized by using scanning electron microscopy (SEM) to evaluate pore size, pore distribution, surface structure, and overall network architecture. Whereas mechanical properties were studied using uniaxial compression and rheological testing. The cytotoxic response of ARPE-19 cells to the nanodiamond hydrogel was assessed using morphological imaging and WST-1 metabolic activity measurements across a dilution series (1:100–1:10 v/v). Future work will be focused on revealing that body-temperature-triggered hydrogel responses enable predictable and sustained drug release profiles under physiological ocular conditions, significantly extending drug residence time compared to conventional delivery approaches.

Tunable NanoGUMBOS for Biomedical Applications

Jason Abboud, Suzana Hamdan, Isiah M. Warner

NanoGUMBOS are nanomaterials derived from GUMBOS—Group of Uniform Materials Based on Organic Salts—a class of compounds that combine the tunable properties of ionic liquids with the structural versatility of solid-state materials. With melting points ranging from 25°C to 250°C, GUMBOS can be engineered to exhibit diverse functionalities, including fluorescence, magnetism, hydrophobicity, and bioactivities such as antibacterial, antifungal, and anticancer effects. These properties have enabled their integration into a wide range of biomedical applications. At the nanoscale, nanoGUMBOS demonstrate enhanced bioactivity and physicochemical characteristics tailored for targeted therapeutic and diagnostic use. They have been successfully applied in selective cancer cell targeting, hemoglobin isolation from whole blood, and molecular recognition of amino acids. Furthermore, nanoGUMBOS have been developed as multifunctional theranostic agents—magnetic, fluorescent, and pH-sensitive—as well as imaging probes, owing to their dynamic spectroscopic behavior. This poster will highlight the development and biomedical potential of nanoGUMBOS, showcasing key studies and emerging directions that position them as a versatile platform for next-generation nanomedicine.

Polyelectrolyte-based Nanoparticle Architectures Across Various Chemical Motifs

Baby Saroja, Wasantha Ranatunga, Ram Kadirvel, Mohiuddin Quadir

Polyelectrolyte-based nanoparticle formulation was systematically optimized to investigate how polymer architecture and intermolecular interactions influence particle assembly and physicochemical properties. In the case of polyelectrolytes composed of natural polymers, we utilized hyaluronic acid (HA)-based polyionic complexes prepared by combining HA with positively charged poly (L-lysine)(pLys). The components were mixed in aqueous conditions to promote spontaneous electrostatic self-assembly. Functionalized HA variants were also prepared via carbodiimide coupling, followed by particle isolation by centrifugation and resuspension. This generation established a reproducible electrostatic approach for forming polymeric nanoparticles. For a more structurally engineered platform, we used poly (ethylene glycol)-poly (lactic-co-glycolic acid) PEG-PLGA and poly (ethylene glycol-block-poly (aspartic acid), PEG-PLD derivatives. PLGA-PEG was conjugated to PLGA block via carbodiimide-mediated conjugation and subsequently used to generate functional polymer derivatives, such as PEG-PLGA and its fluorescently labeled variants. Nanoparticles were purified by dialysis and produced formulations suitable for characterization by dynamic light scattering. Overall, these polyelectrolyte nanoparticles demonstrate a progression from conventional polysaccharide or polypeptide-based electrostatic assembly to multifunctional block-copolymer nanoparticles. This comparative development provides a framework for evaluating how formulation complexity, polymer composition, purification strategy, and self-assembly conditions affect nanoparticle preparation and stability.

Keywords: nanoparticles; polymeric self-assembly; polyionic complexes.

Thermo-Plasmonic Template-Guided Assembly of Photonic Crystals

Brandon Ugbesia, Anna Pyayt

Colloidal self-assembly is one of the most widely used bottom-up approaches for fabricating photonic crystals (PhCs), offering a cost-effective and scalable route to large-area periodic structures and the spontaneous formation of bulk three-dimensional crystals with submicron periodicity. Despite their affordability, many colloidal self-assembly fabrication methods have commercial limitations, including non-uniformity and lack of control, insufficient optical performance and reproducibility, and long fabrication times. While methods such as shear-assisted assembly at ultrahigh particle volume fractions can improve the ordering, uniformity, and reproducibility of colloidal photonic crystals, they primarily control microscale crystal orientation rather than the macroscopic geometry of the assembled structure. In addition, these methods require high particle concentration and careful optimization of processing conditions. This study builds upon the assembly of photonic crystals using thermoplasmonics. This study uses 3D-printed molds to create patterned PDMS templates that spatially confine photonic crystal self-assembly into defined geometries on a chromium-gold substrate. Thermoplasmonic heating is used to assist in filling the templates, enabling reproducible formation of square photonic crystal structures. The structures were characterized using broadband illumination and imaging to evaluate their transmission, reflection, and structural color properties. Fiji software was used for color analysis and VIBGYOR color composition analysis relevant to sensing applications. This method has successfully been used to achieve uniformity, controlled fabrication, reproducibility, and shorter fabrication time.

Development and Characterization of PEGylated Hyperbranched Polymer Nanocarriers for Therapeutic Payload Delivery

Anik Biswas, Mohiuddin Quadir

Highly monodispersed branched polymers, including hyperbranched polyamines and polyols, are versatile hydrophilic macromolecules with abundant surface functional groups that enable extensive chemical modification and support their development as nanoscale platforms for therapeutic payload delivery. In this study, we developed and modified a PEG-conjugated hyperbranched polyol. The polyols were first modified to produce carboxylated derivatives, which were later conjugated with amine-terminated methoxy polyethylene glycol (m-PEG-NH2) with molecular weights of 1 and 5 kDa. We observed that the derivatives forms conjugates which showed concentration-dependent aggregation behavior in water.

Structural modifications at different stages of synthesis were evaluated using proton nuclear magnetic resonance (1H NMR) spectroscopy. Comparison of the spectra of PEG-conjugated and PEG-free polyols demonstrated changes consistent with sequential carboxylation and PEG conjugation. Dynamic light scattering (DLS) was used to evaluate the hydrodynamic size and dispersity of the polymeric systems in aqueous media. The resulting materials exhibited nanoscale hydrodynamic dimensions, while PEG molecular weight influenced the physicochemical characteristics of the modified polyol systems.

Collectively, the sequential conversion of polyol modifications establishes a versatile strategy for tuning the surface chemistry and physicochemical properties of polymeric nanomaterials. This functionalization approach highlights the broader potential of surface-rich hyperbranched polymers, which can be used as adaptable platforms for incorporating therapeutic cargos, targeting ligands, nucleic acid and other functional components for constructing advanced drug delivery systems.

Kinetic Energy of Superconducting Split-Ring Resonators for Quantum Computing

Peter Kveton, Jiangfeng Zhou

Quantum computing relies on the ability to prepare, control, and read out quantum states, which requires efficient interactions between spins and electromagnetic fields. Many quantum excitations associated with spin systems occur at terahertz (THz) energy scales, yet spins interact only weakly with THz radiation. Metamaterials, particularly split-ring resonators (SRRs), provide an engineered solution by strongly enhancing and localizing THz electromagnetic fields, enabling controlled electromagnetic environments for stronger spin–photon interactions. The coupling between spins and photons relies heavily on the single photon magnetic field which is proportional to the inverse square of the total stored energy. Designs using superconducting Niobium Nitride (NbN) thin films were optimized to achieve a high-quality factor resonance near 0.3 THz. To better understand the influence of superconductivity on resonator performance, we investigate the contribution of kinetic inductance to the total stored energy generated from the inertia of Cooper pairs within the material. Simulations show that the kinetic energy contributes to about half of total magnetic response, showing a significant contribution in the total energy. Thus, the kinetic inductance acts as an additional degree of freedom for achieving higher spin-photon coupling for quantum applications.

Quantum Coherence of Excitons Strongly Bound to the Magnetic Order

Sean Knapp, Arup Barua, Chevy Boegel, Shirin Mozaffari, Matthew Cothrine, David Mandrus, Dmitry Semenov, Stephen A. McGill, Aldo H. Romero, Nihard Pradhan, Denis Karaiskaj

Excitons in NiPS3 have shown very strong coupling to the antiferromagnetic order and exceedingly sharp photoluminescence line width, indicating very long quantum coherence. A long excitonic coherence has been inferred so far but never measured directly. Here, we start by investigating the substructure of the excitonic transition using high magnetic fields and confirm the nature of the different spectral components observed and strong coupling to the magnetic order. We conclude that the subcomponents of the excitonic transition originate from the three equivalent orientations of the Neel vectors. Surprisingly, these transitions are shifted energetically and are independent of each other. We perform four-wave mixing experiments and measure the excitonic dephasing rate at ~20 ps, which corresponds to a homogeneous line width of < 20 μeV. To further investigate the coherence time observed, the radiative lifetime of the excitons is measured. The radiative lifetime is half that of the excitonic coherence and is thought to be the limiting factor in setting the upper limit of the coherence time.

Effects of Ozone Aging on the Clould Condensation Nuclei Activity of Wildfire-Derived Phenolic Aerosols

Minh Tran, Alexander Geogiev, Rayhanna Harper, Brandon Osorto, Emily Nortmann, Bui Khe, Chloe A. Haddan, Denisia M. Popolan-Vaida

Wildfires are an increasingly important source of atmospheric organic aerosols that influence air quality, cloud formation, and climate. Phenolic acids produced through lignin degradation are important components of biomass-burning organic aerosols. During atmospheric transport, these compounds undergo chemical aging through reactions with atmospheric oxidants such as ozone (O_3), which can alter their chemical composition and physicochemical properties and consequently affect aerosol–cloud interactions. In this study, we investigated the effects of heterogeneous O_3 oxidation on the hygroscopicity of four atmospherically relevant phenolic acids: vanillic, syringic, ferulic, and gallic acids. Fresh particles exhibited distinct hygroscopicity parameters (κ), following the order gallic acid > ferulic acid > syringic acid > vanillic acid. This trend indicates that particle water uptake is governed not only by the number of oxygen-containing functional groups but also by broader molecular structural characteristics. The reactive uptake coefficients for heterogeneous O_3 oxidation ranged from 2.0×10^{-7} to 5.23×10^{-7}, indicating relatively slow ozone uptake for all four compounds. Despite these modest differences in reactivity, O_3 aging significantly increased κ in every system. Vanillic acid exhibited the lowest uptake coefficient (2.0×10^{-7}) but the largest relative increase in κ, from 0.00035 to 0.002. Ferulic and syringic acids had similar uptake coefficients (3.23×10^{-7} and 3.27×10^{-7}), with κ increasing from 0.006 to 0.023 and 0.004 to 0.018, respectively. Gallic acid exhibited the highest uptake coefficient (5.23×10^{-7}) and the greatest absolute increase in κ, from 0.015 to 0.065. The hygroscopic response did not scale directly with O_3 uptake kinetics, suggesting that the composition and polarity of oxidation products also play an important role. Overall, O_3 aging substantially enhanced the water uptake and cloud droplet activation potential of wildfire-derived phenolic aerosols, highlighting the importance of composition dependent chemical aging in atmospheric models of biomass burning aerosol-cloud interactions.

Capacitive MEMS Accelerometer for Hypersonic Applications

Logan DiFiore, Brett Freidkes, Ashok Kumar

With the ever-expanding aerospace and defense industries within the state of Florida and across the United States, the demand for advanced, high-performance MEMS sensors continues to grow. As these industries push the boundaries of speed and precision, the sensing technologies that support them must evolve to meet increasing performance requirements. Despite this growing demand, there is currently a significant lack of capacitive sensors capable of operating in high-g environments, specifically for accelerations exceeding 20,000 g's. This gap presents a critical challenge for applications in hypersonics, ballistics, and other high-impact aerospace and defense systems where accurate acceleration measurement is essential for both performance and safety. This research presents the design, optimization, and fabrication of a novel capacitive accelerometer with an upper dynamic range of 30,000 g's. The sensor was designed using models derived from first principles, including Euler-Bernoulli beam theory and the Rayleigh-Ritz method, then further refined through a combination of finite element analysis (FEA) and analytical methods to determine the precise geometry needed for reliable operation at the targeted acceleration levels. Fabrication utilizes traditional silicon wafers and bulk micromachining techniques, demonstrating design viability through commercially available processes. Modeling and optimization were completed successfully, confirming a viable sensor geometry within the targeted dynamic range. Fabrication is scheduled for completion within the year, alongside testing to verify electrical separation of the diodes and confirm that the proof mass moves freely as intended. This research will continue expanding the dynamic range of capacitive accelerometers, laying the groundwork for next-generation sensor development for hypersonic and aerospace applications as these industries grow in prominence across Florida and the nation.

Concentration-Dependent Morphology of Biodegradable PVA Nanofibers for Wearable Sweat Biosensors

Rahela Dolha, Erica Schade, Mubarak A Mujawar

Portable and wearable biosensors have demonstrated significant value by enabling the monitoring of biological indicators in any geographical location while substantially reducing associated costs. However, many such sensors lack proper amplification and sensitivity to accurately measure biological markers. The current work focuses on optimizing a biodegradable nanofiber matrix to enhance biosensor amplification and sensitivity. The work investigates biodegradable poly(vinyl alcohol) (PVA) nanofiber matrices as high-surface-area interfaces for future wearable sweat-sensing devices. PVA solutions containing 5, 7, 10, and 13% w/v polymer were prepared using the electrospraying deposition method under fixed initial conditions of ~ 20 kV applied voltage, a 10 cm needle-to-collector distance, a 0.1 mL h−1 flow rate, and a one-hour deposition time. The as deposited structures were characterized by scanning electron microscopy to evaluate fiber formation, morphology, uniformity, and diameter distribution. Our results show that nanofibrous networks were successfully produced at all the investigated concentrations. However, morphology of nanofibres depended strongly on the concentration of PVA. The 5% w/v sample produced comparatively uniform fibers with diameters of approximately 168–314 nm, while the 7% sample showed a broader range of approximately 195–674 nm. Increasing the concentration to 10% generated fibers ranging from approximately 157 to 2111 nm, and the 13% sample produced substantially thicker fibers of approximately 954–3262 nm. These results indicate that lower PVA concentrations provide improved diameter uniformity and more predictable network morphology, whereas higher concentrations promote greater chain entanglement and broader fiber-size distributions. The biodegradable nature of this sensor allows for environmentally conscious disposable of single-use sweat sensors, and the nanofiber matrix provides additional amplification and increased electrochemically reactive surface area for increased sensitivity.

Comparative Analysis of Classical and Modified Stöber Silica Nanoparticle Synthesis for Glioblastoma Drug Delivery

Nayred Aguilera, Nicole Schachter, Annie Nunez, Matty Sey, Anthony McGoron

Recent advances in the biomedical field include nanoparticles used in drug delivery and imaging, as well as their ability to act as both therapeutic and diagnostic tools. Nanoparticles and nanogels represent two major classes of drug delivery systems at the nanoscale, each with distinctive structural and functional characteristics that influence their interactions with biological systems. Mesoporous silica nanoparticles (MSNs) have emerged as a promising drug delivery platform due to their tunable pore size, biocompatibility, and ability to carry a wide range of therapeutic molecules. This study aims to optimize the synthesis of silica nanoparticles by comparing classical and modified Stöber methods, with the goal of evaluating the effect of surfactant templating, solvent system, and catalyst on the properties of the nanoparticles relevant to future glioblastoma drug delivery. Dense silica nanoparticles were synthesized by the classical Stöber method from ethanol, water, ammonium hydroxide, and tetraethyl orthosilicate (TEOS). Mesoporous silica nanoparticles were synthesized using the modified Stöber method with triethanolamine (TEA), cetyltrimethylammonium bromide (CTAB), and a biphasic water/n-hexane system. The classical Stöber synthesis led to dense silica nanoparticles with an average diameter of 250–260 nm and a zeta potential of -50 mV. The modified synthesis yielded nanoparticles with an average diameter of 150 nm and a zeta potential of -40 mV. These findings demonstrate that the size and surface properties of silica nanoparticles and their suitability as drug delivery vehicles are heavily affected by modification of the solvent system, surfactant templating and the choice of catalyst. This comparative synthesis platform provides a basis for the optimization of mesoporous silica nanoparticles for optimal Doxorubicin encapsulation, future surface functionalization, and targeted intravenous or intranasal drug delivery. Future studies will evaluate the cytotoxicity, cellular uptake, and blood-brain barrier transport of nanoparticles in glioblastoma cells and three-dimensional spheroid models.

Prodrug Encapsulated Blood Brain Barrier Penetrating Nanoparticle for Targeting Metabolic Vulnerabilities in Heterogeneous Glioblastoma

A. Ashokan, S. Sarkar, B. Surnar, S.Lepore, D. C. Bilbao, M. E. Ivan, and S. Dhar

Glioblastoma Multiforme (GBM), a highly aggressive brain tumor with a poor prognosis due to its rapid growth, invasive nature, and resistance to treatment caused by the presence of heterogenous glioblastoma stem cells (GSCs) equipped with its self-renewal properties. Its treatment is challenging due to the blood-brain barrier (BBB), genetic heterogeneity, and inability to remove infiltrating tumor cells completely. Specific targeting of GSCs through surgical resection and radio/ chemotherapy to eliminate GSCs remains a major challenge. In its highly invasive nature, residual GSCs persist after conventional treatment, leading to tumor recurrence and making glioblastoma resistant to potential therapies. Thus, we develop a nanoplatform that penetrates BBB and accumulates in the hyperpolarized GSCs thereby delivering the nanotherapeutics. Preliminary studies on recurrent and newly diagnosed patient-derived GSCs revealed its high dependency on fatty acid oxidation (FAO) for energy, however, inhibiting FAO alone cannot reduce the proliferation of GSCs due to their metabolic plasticity to shift towards glycolysis once FAO is inhibited, and leads to tumor cells survival. To address this challenge, we developed a combinatorial nano-formulation designed to sequentially target and inhibit both FAO and glycolysis, effectively disrupting the tumor's energy production pathways. Platin-L and Platin-P two cisplatin prodrugs with varying FAO inhibitory capacity and Mito-DCA, a DCA prodrug with glycolysis inhibitory capacity, we developed brain-targeted nanoparticles encapsulating either Platin-L or Platin-P along with nanoparticles encapsulating Mito-DCA to administer in a sequential manner and achieve complete metabolic shutdown of GSCs. Our findings suggest this combinatorial nanotherapeutic strategy potentially reduces stemness and proliferation while showing a significant reduction in tumor progression in vivo. We also observed that the more effective FAO inhibitor, Platin-P encapsulated nanoparticles, combined with Mito-DCA, significantly reduced tumor progression even in less aggressive GSCs. This suggests the potential for administering prodrugs based on the tumor's heterogeneity and aggressiveness. This work will explore our detailed findings on nano-formulations, highlighting metabolic inhibition as a promising strategy to target GSCs and limiting glioblastoma progression.

Low-Cost, Resin-Based Additive Manufacturing for Microfluidic Mold Fabrication

Sam Meetre, Nathaniel G. Hermann

Additive manufacturing with photopolymer resins has shown potential in the fabrication of molds for polydimethylsiloxane (PDMS) microfluidic devices, reducing the need for specialized cleanroom facilities. However, this potential is limited by material compatibility problems resulting in the inhibition of PDMS curing and reduced mechanical strength of cured PDMS. Given the centrality of PDMS to microfluidics prototyping and development, overcoming these limitations would allow for rapid and inexpensive production of molds via vat-photopolymerization. We examine three protocols for overcoming these limitations within a low-cost additive manufacturing workflow: first, we demonstrate heated-post treatment of resin molds and high-temperature annealing of cured PDMS as a method to overcome material limitations; second, we develop resin-printed masters as a method to fabricate intermediary polycaprolactone (PCL) molds that preserve printed geometry while separating PDMS from the inhibitory resin surface; third, we assess the viability of water-soluble photopolymers for low-volume, sacrificial molds for encapsulated PDMS structures. Each workflow is evaluated for PDMS mechanical properties, microchannel feature fidelity, and surface contamination.

Toxic Metal Removal with NanoWipes for Cancer Risk Reduction

Arka Banerjee, Akash Ashokan, Alberto J. Caban-Martinez, Erin Kobetz, Shanta Dhar

Combustion driven toxicity and developed carcinogens can lead to higher risk of cancer occurrence among firefighters. Their hazardous work environment and extensive exposure to toxicity, elevate risk of cancers compared to others. Recent epidemiological study showed high risks of malignant melanoma, prostate and colon cancers are majorly occurring among firefighters.1 Major occurrence of melanoma is not solely due to UV exposure as recent studies involving ~ 2400 active firefighter personal in the state of Florida showed ~ 4.5% of respondent suffer from different classes of skin cancers including both melanoma and non melanoma.2 These results indicates long term effect of metal deposition and other toxic materials leading to cancer occurrence. As a potential solution for early removal of metals, we hypothesized design and construction of novel wipes capable of removing toxic metal ions deposited on firefighters' skin as well as gears. We have synthesized a nanoparticle having surface functionalization with a versatile non toxic chelating agent, further coated on commercially available non toxic wipes as a fast and effective tool to quick removal of metal ions. Primary results indicated nanoparticles with smaller size distribution with high surface charge depicting higher colloidal stability. When coated on wipes, substantial toxic metal ions, majorly found in fire incidents were chelated on wipes. These novel nanochelate coated wipes were used on metal contaminated surfaces showing appreciable metal decontamination paving a path to development of successful prototype providing a quick and effective solution to toxic metal removal. These wipes will be further tested for safety and biocompatibility as well as metal removal abilities from animal skin surface and other biorelevant surfaces to achieve closer real time cohort scenarios for firefighter usage.

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Synthesis of Red-Emissive Carbon Dots from Cyanine Fluorophores for Bioimaging

Annu Joji, Eduardo A. Veliz, Roger M. Leblanc

Near-infrared (NIR) fluorophores are indispensable tools in biomedical imaging due to their ability to penetrate deep tissue, minimize background autofluorescence, and enhance signal-to-noise ratios. However, many conventional organic dyes suffer from photobleaching, limited aqueous solubility, and insufficient brightness, restricting their long-term biological utility. To address these challenges, this study focuses on the design, synthesis, purification, and characterization of cyanine-derived fluorophores as red-emissive precursors for carbon dot (CD) fabrication. Cyanine-based scaffolds were selected for their tunable photophysical properties, strong absorption coefficients, and structural flexibility along the polymethine chain. A series of cyanine derivatives were synthesized and systematically modified to achieve red-shifted emission by narrowing the HOMO-LUMO energy gap, enabling fluorescence in the NIR region. These engineered small-molecule chromophores were incorporated into a bottom-up CD synthesis strategy, yielding nanomaterials for enhanced photostability, aqueous dispersibility, and robust red emission suitable for biological applications. The resulting CDs were comprehensively characterized using UV-vis spectroscopy, fluorescence spectroscopy, zeta potential (ZP), and FTIR to confirm their optical behavior, surface chemistry, and colloidal stability. Spectral analysis revealed consistent red-emissive profiles, validating successful chromophore incorporation and demonstrating structure-dependent tunability. Overall, this work expands the molecular design space for red-emissive carbon dots and establishes cyanine fluorophores as versatile building blocks for bioimaging nanomaterials, bioconjugation platforms, and drug-delivery systems. The synthesized CDs show strong potential for fluorescence-based diagnostics, cellular imaging, and targeted therapeutic applications where bright, stable NIR emission is essential.

Point-of-Care Bioluminescence-Based Detection of Urinary Tract Infections and Antimicrobial Resistance

Natalia Cisneros, Pratibha Joshi, Leyla Lindsey, Emre Dikici, Sylvia Daunert, Sapna Deo

Urinary tract infections (UTIs) are among the most common bacterial infections, and their effective treatment is increasingly complicated by antimicrobial resistance (AMR). Our laboratory previously developed a bioluminescence-based assay using Photobacterium leiognathi (P. leiognathi), a marine bacterium whose oxygen-dependent light emission is quenched in the presence of uropathogens, enabling rapid diagnosis of urinary tract infections.1 We have also demonstrated a complementary bioluminescence method, based on ATP detection, capable of screening UTI-positive samples for antibiotic resistance, a tandem bioluminescent test using a portable luminometer.2 While these two assays can currently be performed in tandem, our goal is to combine UTI and AMR detection into a single unified assay, which requires understanding the mechanism underlying P. leiognathi bioluminescence loss. We hypothesize that as Escherichia coli (E. coli) grows aerobically, it depletes available oxygen, directly suppressing P. leiognathi's oxygen-dependent luminescence, such that higher E. coli burden corresponds to greater signal loss. However, multiple mechanisms may contribute to this loss beyond oxygen depletion, including toxic bacterial secretions that kill P. leiognathi outright, or other pathogen-derived chemicals that inhibit the luminescence reaction without killing the cells. To distinguish among these possibilities, we are conducting mechanistic studies beginning with oxygen depletion, based on preliminary data supporting this pathway. Our approach correlates E. coli growth and concentration with real-time dissolved oxygen measurements, alongside a complementary experiment growing P. leiognathi under defined, pre-set oxygen concentrations to directly demonstrate that reduced oxygen alone decreases bioluminescence. We are currently standardizing bacterial culture inoculum numbers as a foundational step for these studies. Clarifying this mechanism will guide development of a single, unified bioluminescence platform for simultaneous UTI detection and AMR screening, offering a rapid, low-cost diagnostic tool for resource-limited settings.

Point-of-Care Electrochemical Sensing of Microplastic

Joshua Morris, Daniel Fellows, Justin Sanchez-Almirola, Riley Orr, Dan Vo, Ajeet Kaushik

The rapid expansion of plastic waste breakdown into micro/nano-plastics (M/N-Ps) poses significant environmental and bioaccumulative health risks, requiring sensitive detection platforms to replace costly, complex analytical methods. Here, we present a point-of-care (PoC) electrochemical sensor utilizing molecularly imprinted polymers (MIP) for the sensitive detection of polystyrene (PS) nanoparticles (nPS). Screen-printed carbon electrodes (SPCE) were modified via electro-polymerization of poly-o-phenylenediamine (PoPD) around 100 nm and 500 nm nPS templates. Target template elution was carried out using a 50/50 methanol and deionized (DI) water solution for 30 min to generate selective imprinted recognition cavities. Following a 10 min analyte incubation and DI water rinse, sensor performance was evaluated using cyclic voltammetry (CV), differential pulse voltammetry (DPV), and chronoamperometry (CA) interfaced with portable potentiostats. The MIP-PoPD-SPCE sensor demonstrated rapid detection within 15 min, exhibiting a linear dynamic range from 2.1×10-9 g/L to 2.1×10-4 g/L across both 100 nm and 500 nm particle sizes. Furthermore, the platform achieved an ultra-low limit of detection (LOD) down to 4 parts per billion (4.2×10-9 g/L). This MIP-assisted electrochemical sensing strategy provides a scalable, affordable, and portable alternative for point-of-need environmental surveillance of microplastics, with ongoing work directed toward selectivity testing in complex real-world matrices.

Probing Extracellular Exosomes with Scattering Near-Field Optical Microscopy (SNOM)

Oscar Sang, Hannah Ambrosius, Qun Huo, Alfons Schulte

Scattering near-field optical microscopy (SNOM) employs light scattered from the tip of an atomic force microscope as an extremely localized probe of materials below the diffraction limit. Employing infrared excitation in the infrared fingerprint region we present spectrally resolved maps with sub 50 nanometer resolution of biological systems. Exosomes are biological nanoparticles released from cells and are potential disease biomarkers. Using SNOM, we observed significant differences in shape, size, and amide I / amide II infrared absorption band between healthy and cancerous exosomes isolated from human plasma. Exosomes with diameters as small as 20 nm were detected.

MIP-Assisted Electrochemical Sensing of L-thyroxine (T4) for Thyroid Diagnostics

Daniel Fellows, Joshua Morris, Justin Sanchez-Almirola, Riley Orr, Dan Vo, Ajeet Kaushik

Monitoring L-thyroxine (T4) levels is critical for managing hypothyroidism, a condition affecting millions of individuals annually. Traditional monitoring relies on ELISA-based (Enzyme-Linked Immunosorbent Assay) blood serum assays, which are highly accurate but unsuitable for rapid point-of-care (POC) testing. To address this limitation, this work demonstrates a molecularly imprinted polymer (MIP)-assisted electrochemical sensor designed for non-invasive, rapid, and selective detection of T4 at concentrations relevant to human saliva.

The sensor was fabricated by electropolymerizing o-phenylenediamine (oPD) monomer onto a screen-printed carbon electrode (SPCE) in the presence of T4. After template elution, the sensor was characterized and tested across real-world concentration ranges using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) on a multi-channel potentiostat platform.

The developed sensor achieved reliable, parts-per-billion (ppb) level detection of T4 within 15 minutes of exposure. Calibration plots showed a strong linear relationship between peak amperage and the logarithm of T4 concentration.

These results confirm the successful application of MIP-based electrochemical sensing for T4 diagnostics. Future efforts will focus on evaluating sensor performance in human saliva samples, integrating reduced graphene oxide nanoparticles to enhance sensitivity, and adapting the platform for smartphone-based potentiostat systems to enable field-deployable POC applications.

The q-sc-SF-EOM quantum algorithm for ground and excited-states in molecules and solids

Ines Alonso, David A. Strubbe, Bradford A. Barker

We present the quantum self-consistent Spin-Flip Equation of Motion (q-sc-SF-EOM) quantum algorithm. The previously established quantum self-consistent Equation of Motion algorithm and Spin-Flip Equation of Motion approach from quantum chemistry are combined in this work to arrive at an algorithm for computing ground- and excited-states of molècules with reduced circuit depth, compared to conventional methods. Beginning with a Hartree-Fock calculation of a High-Spin Reference State, standard implementation of a variational unitary coupled-cluster singles doubles circuit is combined with up-to-down spin-flipping excitations to calculate the matrix elements of the eigenvalue equation determined by the Equation of Motion approach. Because the excitations only require a single pair of fermion operators, the quantum circuit generates the same target states with a reduced circuit depth, up to a factor of three.

Translating Injectable Octreotide into an Oral Therapy Using Donkey Milk–Derived Exosomes: Integrating Nanocarrier Design, PBPK Modeling, and In Vivo Validation

Sandeep Chary Padakanti, Aakash Nathani, Arvind Bagde, Mandip Singh Sachdeva

Oral delivery of peptide therapeutics remains a major challenge because of enzymatic degradation in the gastrointestinal tract and poor intestinal permeability. Octreotide (OCT), a somatostatin analog used to treat acromegaly and neuroendocrine tumors, is limited to injectable formulations, reducing patient compliance. This study developed donkey milk-derived exosomes (DME) as a natural nanocarrier for oral OCT delivery and evaluated their translational potential through in-vitro, in-silico, and in-vivo studies.

Exosomes were isolated from donkey milk powder using sodium citrate precipitation followed by ultracentrifugation and characterized by nanoparticle tracking analysis, zeta potential, protein quantification, Western blotting (Alix, CD61, CD83, and HSP70), and LC-MS/MS proteomics. OCT was encapsulated using a transmembrane pH-gradient loading method. Drug release was evaluated under simulated gastric and intestinal conditions, while intestinal permeability was assessed using MDCK cell monolayers. GastroPlus® physiologically based pharmacokinetic (PBPK) modeling was employed to predict oral absorption, followed by pharmacokinetic validation in BALB/c mice after oral administration.

DME exhibited a mean particle size of 136.2±0.65 nm, a zeta potential of −33.3±0.23 mV, and a protein concentration of 2.5±0.24 mg/mL. Proteomic analysis identified PIGR, MFGE8, ANXA2, CD9, CD63, and CD81, supporting epithelial transport. OCT loading efficiency reached 7.25±0.23% and provided sustained release. Exosome encapsulation increased intestinal permeability approximately 37.5-fold (Papp: 17.26×10^{-6} vs. 0.46×10^{-6} cm/s; $p < 0.0001$). PBPK simulations predicted fraction absorbed increasing from 8.5% to 88.2%, Tmax decreasing from 5.5 to 2.2 h, and a fourfold exposure increase. In vivo, OCT-loaded exosomes achieved a 16-fold higher AUC_{0-24} (435,200 vs. 27,154 pg·h/mL).

These findings demonstrate that DME are a biocompatible and scalable nanocarrier capable of overcoming key barriers to oral peptide delivery. This platform significantly improves intestinal transport and systemic bioavailability of octreotide and represents a promising nanomedicine strategy for the noninvasive oral delivery of peptide therapeutics with broad translational potential.

Multiplex Cytokine and NK-Associated Secretome Profiling Demonstrates Immune Reprogramming by miR-34a-Loaded Lyophilized NK Exosomes in Lung Cancer

Aakash Nathani, Sandeep Chary Padakanti, Li Sun Aditi Basu Bal, Yan Li, Arvind Bagde, Mandip Singh

MicroRNA (miRNA)-based therapies, particularly miR-34a-5p, possess potent tumor-suppressive activity but are limited by poor stability, rapid degradation, inefficient tumor delivery, and off-target toxicity. This study developed miR-34a-5p-loaded lyophilized natural killer (NK) cell-derived exosomes as a stable therapeutic platform and evaluated their physicochemical characteristics, sustained release, antitumor efficacy, molecular mechanisms, and immunomodulatory effects in lung cancer models. NK92-MI cells were expanded in an Electric and Chemical Hypoxia Optimized (ECHO) bioreactor to enhance exosome production. Exosomes were isolated, lyophilized using an optimized cryoprotectant formulation, loaded with miR-34a-5p by electroporation, and characterized by nanoparticle tracking analysis, transmission electron microscopy, agarose gel electrophoresis, western blotting, zeta potential analysis, and controlled release studies. Therapeutic efficacy was evaluated in Lewis lung carcinoma (LLC) and patient-derived xenograft (PDX) lung cancer models through cytotoxicity, cell-cycle analysis, signaling pathway evaluation, multiplex cytokine profiling, NK-associated secretome analysis, immune-cell co-culture studies, and in vivo antitumor efficacy. Lyophilized miR-34a-5p-loaded NK exosomes maintained structural integrity, preserved exosomal and NK-associated protein expression, demonstrated sustained miRNA release, and remained stable during long-term storage. Treatment significantly reduced tumor cell viability, induced S-phase cell-cycle arrest, activated the stimulator of interferon genes (STING)/TANK-binding kinase 1 (TBK1)/interferon regulatory factor 3 (IRF3)/signal transducer and activator of transcription 1 (STAT1) signaling axis, suppressed protein kinase B (AKT) and cyclin-dependent kinase 6 (CDK6), reduced pro-inflammatory cytokines, enhanced secretion of natural killer effector molecules including perforin, granzyme B, granulysin, and interferon-γ, increased antitumor immune responses, and markedly inhibited tumor growth, particularly in combination with paclitaxel. Multiplex cytokine analysis revealed coordinated suppression of multiple pro-inflammatory cytokines, including MCP-1, IL-6, IL-1β, and GM-CSF, indicating reversal of the immunosuppressive tumor microenvironment. Lyophilized miR-34a-loaded NK exosomes provide a stable, scalable, and multifunctional platform for miRNA delivery that integrates direct tumor suppression with immune reprogramming, supporting their translational potential as a next-generation cancer immunotherapy for lung cancer.

Effect of Molecular Structure on the Thermodynamic Behavior of Hydrocarbons Confined within Nanopores

Daniel Lockhart, Autum Hiner, Hyeyoung Cho

ZIF-8 (Zeolitic Imidazolate Framework-8) is a nanoporous material that belongs to a class of materials known as metal–organic frameworks (MOFs). Nanoporous materials have a wide range of industrial applications, including gas separation, water purification, emissions control, and hydrocarbon recovery. ZIF-8 acts as a nanoscale porous structure whose pore environment can be tailored for the capture and confinement of selected molecules. In this research, ZIF-8 is used as a model nanoporous material to study the thermodynamic properties of confined hydrocarbons. ZIF-8 is synthesized through two routes: a room-temperature method using methanol as the solvent and a solvothermal method using DMF (Dimethyl Formamide). X-ray diffraction (XRD) will be used to confirm successful synthesis, while N_2 adsorption–desorption measurements and BET (Brunauer-Emmett-Teller) analysis will be used to determine surface area, pore volume, and pore-size distribution. Differential scanning calorimetry (DSC) will then be used to investigate how molecular structure and chain length influence the thermodynamic behavior of hydrocarbons confined within nanopores.

Cardiolipin Delivery via Nanoparticles: A Potential Treatment for Barth Syndrome

Julia Franco, Ru Wen, Arnab Chakraborty, Akash Ashokan, Shanta Dhar

Barth Syndrome is a rare X-linked disorder caused by mutations in the TAZ gene, resulting in loss of function of the phospholipid acyltransferase Tafazzin. Tafazzin catalyzes the remodeling of monolysocardiolipin into its mature form, a process essential for maintaining mitochondrial membrane integrity and optimizing ATP/ADP exchange. Deficiency of cardiolipin leads to profound mitochondrial dysfunction, manifesting clinically as cardiomyopathy, neutropenia, and skeletal myopathy. To address this enzymatic deficit, we propose a mitochondria-targeted nanoparticle designed for direct cardiolipin delivery. The nanoparticle encapsulates cardiolipin within a hydrophobic core and employs stearyl-triphenyl phosphonium to generate a positively charged outer shell that preferentially targets the mitochondria. This targeted delivery strategy offers a potential therapeutic approach for restoring cardiolipin levels and improving mitochondrial function in Barth Syndrome. We were able to synthesize a mitochondria-targeted cardiolipin nanoparticle with an optimal particle size and strong mitochondrial targeting characteristics. These findings demonstrate the feasibility of this delivery platform as a potential therapeutic strategy for Barth syndrome. Future studies will evaluate its in vitro efficacy, cellular uptake, and ability to restore mitochondrial function.

Delivery Optimization of Non-Colloidal Ferrimagnetic Nanoparticles in a Preclinical Model

Michael Sabo, Leah Morrell1, Thomas Hemmen, Peter Panagos, Francis Creighton

Background: Annually ~8 million individuals suffer acute ischemic stroke (AIS) worldwide. Magnetic control of fibrinolytic protein conjugated iron oxide nanoparticles (IONPs) offers promise for rapidly dissolving AIS clots. Synthesizing IONP cores in the desired size range produces ferrimagnetic behavior sufficient to overcome electrostatic and steric repulsion necessary to maintain a stable colloidal suspension., a novel infusion system was developed to produce a uniform delivery profile of our non-colloidal system, which allowed for toxicity and efficacy testing of thrombolytic conjugated IONPs in preclinical models
Methods: An infusion system with two mechanically coupled 5mL syringes was attached to a custom syringe rocker with the infusion syringe pointing out radially from the wheel, to consistently deliver a ~1 mgFe3O4/kg dose of SiO2 IONPs uniformly across a 15-minute window in the presence of a known magnetic field. Two sizes of micro-urethane tubing were connected to the syringe outlet. Experiments (n=6/arm) were conducted. Iron content for each timepoint sample was measured using a ferrozine assay to confirm delivery profile and total mass delivered.
Results: Iterative design changes produced a delivery system optimized for a consistent mass per unit time profile, developing a syringe loading factor which enabled the use of the system for in vivo studies. Subsequent application of the infusion system in a rat preclinical study (n=32, equal M/F) saw successful dose delivery with no earlier losses and no indications of respiratory or cardiovascular distress.
Conclusion: Breadboard validation (TRL 4) for consistent and reproducible delivery of IONPs to continue therapeutic development for AIS was established. Future work will focus on optimizing intra-arterial delivery to support efficacy studies in a preclinical model later this year. Lessons learned from preclinical testing will inform a commercial embodiment for use in AIS therapy.

Keywords: Ferrimagnetic, IONP, Non-Colloidal, Stroke

Comparative Characterization of Temozolomide-Loaded PGMD and PLGA Nanoparticles for Future Intranasal Glioblastoma Drug Delivery

Matty Sey, Maria Agostina Nobo, Rayan El Messoussi Garti, Micaela Lopez Krol, Anthony J. McGoron

This study compares poly(glycerol malate co-dodecanedioate) (PGMD) and poly(lactic-co-glycolic acid) (PLGA) nanoparticles as carriers for TMZ. Nanoparticles were synthesized using optimized fabrication protocols and characterized to evaluate their physicochemical properties. Particle size, polydispersity index (PDI), and zeta potential were measured using dynamic light scattering, while drug encapsulation and loading efficiency were quantified spectrophotometrically. Nanoparticle morphology was assessed using electron microscopy, and in vitro drug release studies were performed to compare release kinetics.

Preliminary characterization demonstrates successful fabrication of both PGMD and PLGA TMZ-loaded nanoparticles with distinct physicochemical properties. Comparative analysis revealed differences in particle size distribution, surface charge, drug loading capacity, and release behavior, indicating that polymer composition significantly influences nanoparticle performance. These findings provide insight into the advantages and limitations of each polymer platform for therapeutic delivery.

This work establishes a foundation for selecting an optimized nanoparticle formulation for future intranasal delivery studies aimed at improving TMZ transport to glioblastoma while minimizing systemic exposure and enhancing therapeutic efficacy.

Spacer-Thickness Dependence of Interlayer Exchange Coupling and Magnetization Dynamics in NiFe/Ru/FeCo Trilayers

Rejoan Afrin Tonoy, Ibrahim Almuhanna, Rahul Gupta, Ayomipo I. Ojo, and Darío A. Arena

Understanding the magnetization dynamics of exchange-coupled magnetic multilayer structures is crucial for developing advanced spintronic applications, such as synthetic antiferromagnetic (SAF) reference layers in MRAMs and spin-torque oscillators. In this study, we investigate the structural and dynamic magnetic properties of asymmetric NiFe (8 nm) / Ru / FeCo (8 nm) heterostructures grown on oxidized Si substrates, with varying Ru spacer thicknesses (0.4, 0.8, 1.2, 1.6, 2.0, and 20 nm). We characterized the fundamental structural and static magnetic properties of the films via X-ray Reflectivity (XRR) and Vibrating Sample Magnetometry (VSM). We explore the spacer-thickness dependence of interlayer exchange coupling (IEC) using broadband ferromagnetic resonance (FMR) spectroscopy with the magnetic field applied parallel to the sample plane. Our FMR spectra reveal distinct coupled modes termed acoustic and optic resonances. The FMR results confirm that the IEC can be controlled by varying the Ru spacer thickness. Modifying the Ru thickness can change the coupling from ferromagnetic (parallel magnetization in the ground state) to anti-ferromagnetic (anti-parallel ground state). Current analyses focus on quantifying the coupling strength and determining the Gilbert damping in the tri-layer structures.

A Cool Way to Protect the Brain

Jorge David Tovar-Castro, Alexia L Kafkoutsou, Emre Dikici, Juliana Sanchez-Molano, Sapna Deo, W Dalton Dietrich, Helen M Bramlett, Sylvia Daunert

Therapeutic hypothermia offers a promising neuroprotective strategy for acute brain injuries such as traumatic brain injury and ischemic stroke. However, current methods require external cooling, which is slow and imprecise. We developed a novel intranasal nanodrug platform using non-pungent TRPV1 agonists to induce rapid, pharmacologically-driven brain cooling without systemic side effects. Using bottom-up reprecipitation, we formulated stable, sub-200 nm vanilloid nanodrugs and optimized their delivery with a custom 3D-printed intranasal spray device. In vitro studies confirmed TRPV1 activation and epithelial compatibility, while in vivo dosing in rats demonstrated rapid head temperature reduction within 20 minutes, sustained for over 100 minutes. Our findings support intranasal nanodrug delivery as a viable, non-invasive approach for fast-acting neuroprotection in emergency care settings.

Results on Biological scatters as medium for Random Lasing

Manuel Giron, Rebecca Robinson, Hengzhou Liu, Nathan J. Dawson

Biological materials are formed by diverse micro and nanostructures whose optical propertiers remain largely unexplored. Naturally occurring nanostructures capable of supporting coherent, resonant optical phenomena could provide an alternative to engineered photonic materials, making them an attractive avenue for further investigation. The goal of our study is to identify a biological photonic material that, after incorporation of a fluorescent gain medium, can support amplified spontaneous emission and ultimately random lasing, while also understanding the underlying morphology that influences optical feedback and emission behavior.

We screened multiple classes of biological materials with distinct morphologies and structural compositions. To do so, we employed a 532 nm Nd laser and incorporated fluorescent dyes into the samples. We then analyzed the emission spectra of the excited samples over a range of pump energies.

Initial measurements indicate measurable differences in emission behavior among the biological materials studied. Several samples exhibited amplified spontaneous emission (ASE), indicating optical amplification. For these samples, we examined the pump-energy dependence to identify emission thresholds. Our current efforts focus on optimizing dye incorporation and expanding the range of biological structures investigated.

This study provides a systematic framework for evaluating naturally occurring biological materials as active photonic media. Understanding the relationship between biological structure and optical response may guide the development of bioinspired photonic technologies and biodegradable optical components.

Shell-Thickness Dependence of Magnetic Hyperthermia Heating in Fe3O4 Aminophenol–Formaldehyde Core–Shell Nanoclusters

Dakota Brown, Dan Luu, Supawitch Hoijang, T. Randall Lee, Manh-Huong Phan

Magnetic Hyperthermia is a therapeutic process which utilizes magnetic nanoparticles within an alternating magnetic field to generate localized heat. These particles typically carry functional polymer shells. Understanding how the thickness of these shells influences heating efficiency and its reproducibility across different particle concentrations and media is crucial for clinical applications. We report a systematic study of the specific absorption rate (SAR) of superparamagnetic iron oxide (Fe3O4) multicore clusters (~225 nm) coated with 3-aminophenol–formaldehyde (APF) shells of 0 (uncoated), 24, 50, and 71 nm. SAR was calculated by the initial-slope method in both deionized water and 2% agar, across particle concentrations of 0.5–2 mg/mL and field amplitudes of 400–800 Oe at 310 kHz. While across all shell sizes, SAR decreased sharply with concentration as a result of interparticle dipolar interactions, the uncoated core exhibited the strongest concentration suppression, whereas the polymer-shelled clusters showed a lower spread in SAR. We attribute this to the shell de-coupling dipole interaction. Initial-slope SAR was comparable in water and agar despite divergence in the full heating curves, indicating that heating effects are primarily the result of Néel relaxation and dynamic hysteresis loss. These results exemplify shell thickness as a tunable route to heating stability.

Surface Activation of Ni3S2@Carbon Nanotube Core-Shell Electrodes for Enhanced Pseudocapacitive Charge Storage

Bipin Paudel, Wenzhi Li

Efficient electrode materials with high charge-storage capacity, rapid charge transport, and long-term stability are essential for advancing electrochemical energy-storage technologies. Here, we investigate surface activation of nickel sulfide (Ni3S2)/carbon nanotube (CNT) core–shell electrodes to enhance pseudocapacitive charge storage at the electrode level. Ni3S2 and CNTs were directly grown on carbon cloth by a one-step chemical vapor deposition (CVD) process, producing a binder-free, three-dimensional conductive framework. In this architecture, the CNT network provides interconnected electron-transport pathways, mechanical support, and an accessible surface area, while Ni3S2, confined within the CNTs as nanowires, supplies redox-active sites for Faradaic charge storage. Controlled nitric acid treatment was applied to activate the electrode surface, improve electrolyte accessibility, and increase utilization of electroactive sites. The optimized acid-treated electrode delivered a specific capacitance of approximately 1200 F g ^{1} at 1 A g^{-1}, representing a significant improvement over the untreated electrode and retaining about 90% of its capacitance after 2300 cycles during stability testing. Rate-dependent cyclic voltammetry, b-value analysis, and Dunn's method were used to examine the charge-storage mechanism and evaluate surface-controlled and diffusion-limited contributions. Electrochemical analysis, together with morphology, phase, and surface-chemistry characterization, indicates that acid treatment enhances charge storage by exposing accessible redox sites and improving charge-transfer pathways. This study emphasizes electrode surface engineering as an effective strategy for optimizing transition-metal sulfide/CNT architectures. More broadly, this work contributes to the development of scalable, binder-free electrode materials for sustainable energy storage, renewable energy integration, portable electronics, and high-power applications.

Plasmon-Assisted Electrochemical CO_2 Reduction on Organic Molecule-Modified Copper Nanostructures

Chhatra Bastola, Govinda Ghimire, Konstantin Bukhryakov, Jin He

Electrochemical carbon dioxide reduction (CO_2RR) on copper surfaces offers a promising strategy to convert greenhouse gases into valuable fuels using renewable electricity. Copper is a plasmonic metal that supports localized surface plasmons—collective oscillations of free electrons generated when the metal is illuminated with light. The energy released from plasmon excitation can create localized electromagnetic fields and energetic charge carriers at the metal surface, potentially enhancing reaction activity and selectivity. In this work, we investigate plasmon-assisted CO_2 reduction on nanostructured copper functionalized with 4-bromothiophenol (4-BTP). We hypothesize that electrochemical and light-induced transformations of 4-BTP modify the local interfacial chemistry at the copper surface during catalysis, thereby enhancing plasmon-assisted CO2 RR and stabilizing key intermediates like carbon monoxide (CO). Additionally, this modified interfacial environment and transformed 4BTP may alter the local electronic structure and influence the plasmonic response during catalysis. We employ in situ surface-enhanced Raman spectroscopy (SERS) to monitor changes at the electrode surface and reaction signatures associated with CO2 reduction and molecular transformation. This approach provides molecular-level insight into how plasmon excitation and molecular surface modification work together to influence electrochemical carbon conversion. By focusing on the transformed 4-BTP/copper interface, this study advances fundamental understanding of light-assisted electrocatalysis at nanostructured solid–liquid interfaces. These insights may guide the rational design of molecule-modified plasmonic electrocatalysts for more efficient CO_2 utilization, carbon recycling, and renewable-energy-driven fuel and chemical production.

Transfer-Matrix Modeling of Graphene and Other 2D Conductors via a 4×4 Scattering-Matrix Formalism

Jayden D. Craft, Michael N. Leuenberger

The standard approach for calculating reflection (R), transmission (T), and absorption (A) in multilayer optical systems is the transfer matrix method (TMM). This method uses electromagnetic boundary conditions at each interface to build a complete description of how light propagates through a layered structure. Although widely used, conventional TMM can become numerically unstable in certain systems, sometimes producing unphysical results. In this work, we use a scattering-matrix (S-matrix) formulation of TMM, which improves numerical stability while preserving the same physical information. We apply this method to systems containing two-dimensional (2D) conductors, such as graphene, and derive the corresponding S-matrix representation. We validate the approach by comparing against well-documented results from standard TMM, including polarization-dependent reflection, transmission, and absorption as functions of incidence angle, as well as the recovery of Brewster's angle. Numerical results were obtained using Python, with future work focused on developing a software package for fast, accurate, and reliable S-matrix calculations in optical devices such as infrared sensors, antireflection coatings, and solar cells.

Characterizing Blue Fluorescing N-Heterocyclic Carbene-Stabilized Gold Nanoclusters

Marissa Alcala, Neda Arabzadeh Nosratabad, Jeff Procida, Hedi Mattoussi

Gold nanoclusters (AuNCs) have attracted significant interest due to their unique photophysical properties and potential applications in sensing, imaging, and nanomedicine. In this presentation, we detail the synthesis of blue-emitting AuNCs stabilized with polyethylene glycol-appended nitrogen heterocyclic carbene ligands (NHC-PEG) through ligand-induced etching of plasmonic gold nanoparticles (AuNPs). Incubation of AuNPs with NHC-PEG in large molar excess promotes digestion of the gold core through the strong affinity of NHC ligands for Au surfaces, resulting in the formation of NHC-Au(I) intermediates, followed by the gradual development of fluorescent AuNCs. The buildup of blue emission intensity with reaction time indicates progressive nanocluster formation. Additionally, carrying out the reaction under heated conditions significantly accelerates core etching and nanocluster growth, reducing reaction times from several days to only a few hours while maintaining strong blue fluorescence. Characterization studies demonstrate the formation of uniformly dispersed AuNCs approximately 1 nm in diameter with a photoluminescence excitation maximum at 375 nm and an emission peak at 460 nm. The resulting nanoclusters also exhibited excellent long-term colloidal and photophysical stability, highlighting this synthetic strategy as an efficient route toward robust NHC-stabilized, fluorescent AuNCs.

Structural, Magnetic, and Magnetotransport Properties of Epitaxial Mn4N Thin Films

Ayomipo I. Ojo, Darío A. Arena

Mn4N is a rare-earth-free ferrimagnet whose high Curie temperature, strong perpendicular magnetic anisotropy, and low saturation magnetization (Ms) make it attractive for spintronics. We report the structural, magnetic, and magnetotransport properties of epitaxial Mn4N films (10, 15, 30, and 42 nm) grown on MgO(001). X-ray diffraction reveals distinct Mn4N(001) and (002) reflections alongside MgO(002), establishing (001)-preferential growth, while the four-fold symmetry of the Mn4N(111) pole figure confirms a cube-on-cube epitaxial relationship with the substrate. Magnetometry reveals wasp-waisted out-of-plane hysteresis loops at all temperatures, signaling a competition between hard and soft magnetic phases. Below 20 K, the hysteresis loops of the 42 nm film change abruptly: the saturation field rises from under 3.5 T to above 6 T at 15 K, and Ms jumps to 488 kA/m at 10 K, having first increased on cooling from 96 kA/m at 300 K to 172 kA/m at 30 K. Concurrently, the coercive field peaks 0.28 T near 30 K before dropping abruptly to 0.18 T at 10 K. The thermal evolution of the longitudinal resistivity shows a metallic trend for all thicknesses, with room-temperature (RT) values of 154.2, 153.9, 141.6, and 172.1 cm for the 42-, 30-, 15-, and 10-nm films, respectively. Furthermore, the anomalous Hall loops (xy = -2.54 μcm at RT, 42nm) show no abrupt change across 20 K even as Ms increases nearly fourfold. This decoupling suggests that the transport dominating sublattice remains stable, and the low-temperature magnetic anomaly likely arises from a weakly coupled component nearly invisible to the conduction electrons.

Early Detection of Acute Kidney Injury from Exhaled Breath in ICU Patients

Alejandra Planells-Devesaa, Daniel F. Del Valla, Ana M. Reyes, Emre Dikici, Alessia Fornoni, Sapna Deo, Carl I. Schulmad, Sylvia Daunert

Acute kidney injury (AKI) is a frequent complication in mechanically ventilated intensive care unit (ICU) patients and is often detected only after serum creatinine rises, limiting opportunities for early intervention. Volatile organic compounds (VOCs) in exhaled breath reflect metabolic and inflammatory changes and may provide earlier indicators of renal stress. Heat-moisture exchange (HME) ventilator filters, routinely used during ICU care, passively capture exhaled VOCs and offer a non-invasive, zero-burden biospecimen for biomarker discovery. Used HME filters were collected from mechanically ventilated ICU patients under institutional review board approval, sealed immediately after clinical use, stored at -20 °C, and analyzed by thermal-desorption gas chromatography-mass spectrometry (GC-MS). VOCs were identified using spectral matching and retention indices and semi-quantified with an isotopically labeled internal standard. Environmental and laboratory blanks were included to control for background contamination. VOC profiles were aligned with clinical data, and patients were classified by AKI status using Kidney Disease Improving Global Outcomes (KDIGO) criteria. GC-MS analysis reproducibly detected aldehydes, ketones, alcohols, alkanes, aromatics, and nitrogen-containing species. Environmental controls confirmed that patient-derived VOC profiles were chemically distinct from ICU background. Longitudinal sampling showed dynamic changes in VOC abundance within individual patients, and unsupervised multivariate analysis separated patient samples from environmental controls, supporting a dominant endogenous breath signal. These findings demonstrate the feasibility of using routinely discarded ventilator filters to capture clinically relevant breath VOCs in critically ill patients and support HME-based VOC analysis as a scalable platform for early AKI biomarker development in critical care.

Understanding Repeatable Laser Emission Spectra Across Extended Gain Envelopes Using Select Fluorophores

Rebecca Robinson, Manuel Giron, Nathan Dawson

We present results of laser emission from the eyespot of male Indian peafowl tail feathers across a series of broad gain envelopes. Our motivation for this study was to isolate the optical mechanisms responsible for the specific wavelength emissions (574 nm and 583 nm) in peafowl feather barbules doped with Rhodamine 6G. By infusing feathers with additional fluorophores and pumping externally with a nanosecond 532 Nd:YAG laser, the emission behavior observed with Rhodamine 6G was extended into new regions of the visible spectrum. Comparative experiments using confined fluorophores in fluorinated ethylene propylene (FEP) tubing were performed to investigate whether similar threshold-dependent behavior could be reproduced in artificial systems. The continuation of this research aims to elucidate the interactions behind these spectral peaks and provide a new perspective on naturally occurring nanophotonic structures.

Synthesis and In Vitro Evaluation of PEG/PEI-Coated Fe_3O_4 Nanoparticles for Magnetic Hyperthermia

Elnaz Jaberolansar, Shah Qasim Jan, Shyam S Mohapatra, Subhra Mohapatra, Hari Srikanth

Cancer remains a leading cause of mortality worldwide, and magnetic hyperthermia has emerged as a promising localized treatment strategy that utilizes magnetic nanoparticles (NPs) to generate heat under an alternating magnetic field (AMF) [1]. In this study, Fe_3O_4 magnetic NPs were synthesized via thermal decomposition and functionalized with polyethylene glycol (PEG) and polyethylene imine (PEI) to enhance aqueous dispersibility, biocompatibility, and cellular uptake. Structural, morphological, and magnetic characterization using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), and magnetic measurements confirmed the formation of phase-pure spinel Fe_3O_4 NPs with uniform cubic morphology. Magnetic hyperthermia experiments conducted in water and agar demonstrated efficient heat generation under AMF exposure, with SAR and ILP values comparable to previously reported hyperthermia systems. In vitro studies using HEK293 cells showed good biocompatibility at NP concentrations ranging from 6.25 to 50 μg/mL, while TEM imaging confirmed successful cellular internalization. Following AMF treatment, cell viability decreased significantly, particularly at higher NP concentrations, highlighting the therapeutic potential of the synthesized NPs. Overall, the combination of controlled synthesis, favorable biocompatibility, efficient cellular uptake, and strong heating performance demonstrates the potential of these Fe_3O_4 NPs as promising candidates for future cancer hyperthermia applications.

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Dynamic Spin-Wave Characterization in Ferrimagnetic Insulators: Time-Resolved Imaging and Frequency-Domain Analysis

Vimukthi D. G. Arachchige, Zuhair Ishraque, Sauviz Alaei, Sebastian Wintz, Yuri Suzuki, Ronny Knut, and Darío A. Arena

We employ time-resolved scanning transmission X-ray microscopy (TR-STXM) using the MAXYMUS at the BESSY II synchrotron, combined with X-ray Magnetic Circular Dichroism (XMCD), to investigate the spin-wave dynamics and magnetic properties of the ultra-low damping spinel ferrite $MgAl_{0.5}Fe_{1.5}O_4$ (MAFO), which can be grown on single-crystal spinel substrates, a capability that arises from the availability of $MgAl_2O_4$ as the only commercially available spinel substrate. Using TR-STXM, we visualize the spin-wave amplitude and phase dynamics across a range of frequencies: 6.57 GHz, 8.57 GHz, 9.28 GHz, 10.07 GHz, and 13.5 GHz. We employ time-resolved scanning transmission X-ray microscopy (TR-STXM) using the MAXYMUS at the BESSY II synchrotron, combined with X-ray Magnetic Circular Dichroism (XMCD), to investigate the spin-wave dynamics and magnetic properties of the ultra-low damping spinel ferrite $MgAl_{0.5}Fe_{1.5}O_4$ (MAFO), which can be grown on single-crystal spinel substrates, a capability that arises from the availability of $MgAl_2O_4$ as the only commercially available spinel substrate. Using TR-STXM, we visualize spin-wave amplitude and phase dynamics across several microwave excitation frequencies, including 6.712 GHz, 7.572 GHz, 9.713 GHz, 11.78 GHz, 12.6 GHz, 13.57 GHz, and 14.29 GHz. These findings provide insight into how local structural or magnetic inhomogeneities influence magnon transport in ferrimagnetic oxide thin films. In the MAFO sample, stripe-like modified regions appear to alter spin-wave transmission and guide propagation along preferred pathways. By examining spin-wave behavior across these regions, this work clarifies how local variations in magnetic properties can produce confinement or channeling effects. Understanding these effects is important for controlling spin-wave propagation in ferrimagnetic insulators and for developing reconfigurable magnonic structures for future spintronic applications.

P22 Nanocage Encapsulation Modulates Magneto Responsive Protein Function

Marium Sultana, Robert J. Usselman

Magneto-responsive proteins offer a promising route for non-invasive control of biological processes; however, systems with tunable and robust responses remain limited. In this study, we develop a genetically defined nanoscale platform based on bacteriophage P22 virus-like particles (VLPs) to modulate magneto-responsive behavior. A light oxygen voltage (LOV)- based module (MagLOV) was fused to the N-terminus of a truncated scaffold protein (SP141), enabling high-copy encapsulation within self-assembling P22 nanocages. Structural and functional characterization, including dynamic light scattering (DLS), transmission electron microscopy (TEM), and confocal microscopy, confirmed the formation and spatial organization of uniform nanocage structures. Optically detected magnetic resonance (ODMR) measurements revealed magnetic field-dependent fluorescence changes, demonstrating magneto-responsive behavior of the encapsulated system. Encapsulation of the MagLOV module altered functional behavior relative to the free protein, indicating that nanoscale confinement modulates protein stability and response dynamics. Together, these results establish P22 nanocages as a versatile and programmable platform for engineering magneto-responsive proteins, with potential applications in magnetically controlled biosensing and non-invasive therapeutic technologies.

Weakly Supervised Deep Learning for Physics-Informed Nanopore Event Detection

Abraham Campos, MD Hossain, Jin He

Nanopore sensing resolves single-molecule translocation events through transient ionic-current blockades whose amplitude, duration, and morphology encode molecular size, charge, and conformation. However, high-rate recordings generate millions of points per minute, while conventional threshold-based analysis depends on manually tuned parameters, struggles with overlapping or morphologically complex events, and reduces each event to limited statistics. These limitations introduce operator-dependent bias and discard information contained in event shape and substructure. Here, we present a physics-informed, weakly supervised Teacher–Student deep learning framework for nanopore event detection without manual annotation. Initial pseudo-labels are generated using a heuristic detector based on the smoothed absolute derivative of the ionic-current signal and a Median Absolute Deviation (MAD) threshold. A Teacher model, consisting of a U-Net with a Long Short-Term Memory (LSTM) bottleneck, refines these labels using a 12-dimensional feature vector incorporating raw current, kinematic derivatives, and multi-scale Teager–Kaiser Energy Operator (TKEO) responses. A streamlined Convolutional Neural Network (CNN)-LSTM Student model is trained to reproduce the refined predictions using only raw current traces. We apply this framework to apo-ferritin translocation through a 22 nanometer (nm) quartz nanopipette at −500, −600, and −700 millivolts (mV). Using only 16 positive windows per training build, the model detects events with sharp temporal boundaries, resolves intra-event substructures beyond conventional thresholding, and generalizes across voltage biases without retraining. Ongoing work applies Uniform Manifold Approximation and Projection (UMAP) to the Student model's LSTM hidden states to test whether learned representations separate voltage-dependent conformational subpopulations and distinguish ferritin from apo-ferritin. This work positions deep learning as both automated detection and a tool for extracting hidden biophysical structure from single-molecule nanopore signals.

Deciphering Early-Stage Insulin Aggregation Dynamics Using Nanopore Sensing

Md Hossain, Nazifa T Ahmad, Ayyalusamy Ramamoorthy, Jin He

Insulin is a well-studied peptide hormone secreted by pancreatic β-cells that exists in multiple forms, including hexamers, tetramers, dimers, and monomers. It is an amyloid-forming protein associated with localized amyloidosis at repeated injection sites. Its aggregation plays a critical role in many diseases and pharmaceutical stability challenges. Under destabilizing conditions, insulin can self-associate into oligomers and larger aggregates. Understanding the early stages of insulin aggregation is important for both biomedical and biophysical research. However, detecting early oligomeric species during the lag phase remains challenging due to their extremely low concentrations, structural heterogeneity, and transient nature. We employ a nanopipette-based nanopore sensing platform to monitor insulin aggregation dynamics at the single-molecule level. This technique detects transient ionic current changes as individual molecules translocate through a nanoscale pipette. By analyzing event rate, dwell time, and current amplitude, we track structural transitions throughout the aggregation process. Time-resolved measurements were performed from 2 to 30 hours under acidic conditions that promote aggregation. Early time points (2–4 h) exhibited sparse, short-duration, low-amplitude signals consistent with monomeric or very small oligomeric insulin species. As aggregation progressed (6–20 h), event frequency increased and spike amplitudes and dwell times became larger, indicating the formation of intermediate oligomers. At later stages (22–30 h), irregular, multilevel spikes with long dwell times were observed, reflecting the emergence of larger aggregates. To better understand insulin aggregation dynamics, we also examined how Zn2+ and Cu2+ ions influence the aggregation process. These results demonstrate that nanopipette-based nanopore sensing enables real-time, size-resolved monitoring of protein aggregation pathways. The approach provides a powerful tool for probing early nucleation events and structural heterogeneity in protein aggregation processes.

Light and Magnetism in One: A Heteroepitaxial Hybrid Gallate/Ferrite CoreShell Design for Nanotheranostics

Shah Qasim Jan, Raja Das, Ayomipo I. Ojo, Yasinthara Wadumesthri, Rajeswari R. Chowdhary1, Humberto R. Gutierrez, Dirk Honecker, Steven Parnell, Julie A. Borchers, Hari Srikanth, Darío A. Arena

Designing a single nanoparticle platform that simultaneously delivers optical imaging contrast and magnetic therapeutic actuation requires precise control over both phase composition and interfacial structure at the nanoscale 1. In this work, we present the synthesis and characterization of a novel hybrid all-oxide spinel core@shell nanoparticle system consisting of a luminescent ZnGa2O4 (ZGO) core and a magnetic Fe3O4 (FO) shell. The nanoparticles were prepared through a two-step seed-mediated growth process that enables the integration of both functionalities while preserving the structural integrity of the individual components. Structural characterization confirms the formation of the hybrid architecture, with polarized small-angle neutron scattering (SANS) analysis providing ensemble-averaged structural dimensions of ~ 22 nm, consistent with transmission electron microscopy observations. Photoluminescence spectroscopy confirms retention of the broadband emission intrinsic to ZGO following shell growth, establishing that the optical functionality of the core survives the encapsulation process. Magnetic measurements reveal a broadened Verwey transition and non-vanishing coercivity over the investigated temperature range. Analysis of the temperature-dependent magnetization using Bloch's law yields an exponent of 2.29, indicating the influence of finite-size effects and magnetic confinement at the nanoscale. High-frequency spin dynamics evaluated via X-band ferromagnetic resonance (9.78 GHz) reveal asymmetric spectra shaped by interparticle interactions and anisotropy distributions. In addition, magnetic hyperthermia studies demonstrate heating behavior governed by a combination of relaxation and hysteresis losses, characterized by a field-scaling exponent of $n = 1.35 \pm 0.23$. These results demonstrate how the heteroepitaxial integration of gallate and ferrite spinels within a core@shell geometry can be used to tailor coupled magnetic and optical functionalities, providing a versatile platform for the development of multifunctional nanomaterials for theranostic applications.

Fundings

1. National Science Foundation (NSF): DMR-2327667
2. US Department of Energy (DOE): DE-FG02-07ER46438

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Design and Evaluation of RGD-Modified PLGA Nanoparticles of Lifitegrast for Corneal Targeted Delivery in Dry Eye Disease

Balavardhan Redday Apur, Vishnu Teja Vattipalli, Augustine Nkembo, Sheeba Varghese Gupta, Priyanka Bhatt, Vijaykumar Sutariya

Dry Eye Disease (DED) is a stubborn and complicated eye problem that hits anywhere from 5% up to half the people on the planet. It messes with your tears how much you make; how stable they are and causes really salty tears along with a burst of T-cell driven inflammation (mostly because of the LFA-1/ICAM-1 pathway). Right now, we've got drugs like lifitegrast (Xiidra® 5%), but they just don't quite get the job done. They don't stay on your eye very long, they get rinsed away quickly, you have to use them twice a day, and that weird taste (dysgeusia) is just annoying since the medicine ends up in your throat. We created nanoparticles out of cyclic RGD (cRGD)-conjugated, PEGylated poly (lactic-co-glycolic acid) (PLGA). They're designed to target the cornea and drop lifitegrast right where it matters. Making these lifitegrast-loaded PLGA nanoparticles used a single oil-in-water emulsion. The PEG corona helps keep the particles from getting gobbled up by the immune system. For the targeting bit, we used cRGDfK, attaching it through a strong, stable thioether bond. RGD latches onto αvβ3 and α5β1 integrins, which are everywhere on inflamed corneal cells in DED. When tested the nanoparticles, they measured about 314.2 nanometers across and had a zeta potential of −30.6 mV. We managed to load up 68% lifitegrast. FTIR proved lifitegrast and PLGA play well together. DSC showed lifitegrast became amorphous in the PLGA-PEG mix. Under TEM, these nanoparticles looked round and well-separated. PEGylation keeps the nanoparticles around longer, and cRGD makes sure they go right to the inflamed corneal cells. The idea is to release lifitegrast slowly and cut down on drainage. What's next? We'll test how the drug releases in fake tear fluid, make sure the particles are stable, watch for toxicity on human corneal cells, and check how well the cells cut down on inflammation markers like IL-1β, TNF-α, and MMP-9.

Keywords: dry eye disease; PLGA nanoparticles; lifitegrast; RGD peptide; corneal targeted drug delivery; LFA-1 antagonist; maleimide-thiol conjugation;

Corneal Targeted Polycaprolactone Nanoparticles for Cyclosporin A Delivery in Dry Eye Therapy: Synthesis, RGD Surface Functionalization, and Physicochemical Characterization

Vishnu Teja Vattipalli, Balvardhan Reddy Apur, Augustine Nkembo, Sheeba Varghese Gupta, Priyanka Bhatt, Vijaykumar Sutariya

Dry Eye Disease (DED) affects 10–20% of adults over 40, characterized by tear film instability, ocular surface inflammation, and lacrimal gland damage. FDA-approved Cyclosporin A (CsA) emulsions (Restasis® 0.05%; Cequa® 0.09%) show less than 1% corneal bioavailability and rapid clearance, creating an unmet need for targeted sustained-release delivery. We hypothesize RGD-conjugated, CsA-loaded polycaprolactone (PCL) nanoparticles will achieve targeted delivery via αvβ3/αvβ5 integrin receptors on inflamed corneal epithelia, improving bioavailability over conventional formulations. CsA-PCL nanoparticles were prepared by oil-in-water emulsification-solvent evaporation with probe sonication (18–24 W), incorporating PLA-PEG-MAL (poly(lactic acid)-poly(ethylene glycol)-maleimide) for maleimide surface groups. RGD peptide (cRGDfK-thioacetyl ester) was conjugated via thiol–maleimide click chemistry after hydroxylamine deprotection, isolated by ultracentrifugation, and lyophilized. Characterization included dynamic light scattering for size and zeta potential, UV-Vis for EE%, FTIR spectroscopy for drug-polymer compatibility, and differential scanning calorimetry (DSC) for drug physical state. Plain CsA-PCL nanoparticles showed Z-average 175.9 nm (polydispersity index, PDI: 0.412) and zeta potential −1.24 mV. Post-conjugation, size increased to 346.4 nm with zeta shift to −22.5 mV, confirming surface modification. FTIR confirmed PCL carbonyl (1720 cm^{-1}) and CsA amide peaks (1620–1690 cm^{-1}) with no new peaks. DSC showed disappearance of CsA crystalline endotherm (~148°C), confirming amorphous dispersal and enhanced bioavailability. RGD-conjugated CsA-PCL nanoparticles were successfully developed with confirmed surface functionalization and amorphous drug state. Future work includes in vitro release profiling, cytotoxicity, cellular uptake in corneal epithelial cells, and in vivo evaluation.

Keywords: Dry eye disease; polycaprolactone nanoparticles; cyclosporin A; RGD peptide; corneal targeted drug delivery; ocular bioavailability; amorphous drug dispersal

Interaction of Nano Plastics Particles within Cuban Oregano, Basil, and Tomato Plants

Logan Yang, Carolynne Carmona, Lucas Doyaga, Andre Gesquiere

Micro- and nanoplastic particles have become a food safety concern as the abundance of plastic particles in nature increases. In this study, we investigate the adsorption of nano plastics on plant roots and internal transport from the root system to the rest of the plant with the specific aim to demonstrate the interaction and effects nano plastics can have on plants. Using Fluorescence Lifetime Imaging (FLIM), a form of nanoscale optical imaging, we attempted to track the interaction of nano plastics with crops. To this end, Tris(2,2-bipyridine)ruthenium(II) hexafluorophosphate ([Ru(bpy)3](PF6)2), dye labelled polystyrene nanoparticles (PS NP) particles were synthesized to map the transport of those particles in planta. The choice of dye was motivated by the need to distinguish the PS NP from the chlorophyll background fluorescence that covers most of the visible spectrum. The charge of micro- and nanoplastics is expected to affect how a plant's root system interacts with the particles. We functionalized the [Ru(bpy)3](PF6)2 labelled nano plastic particles with amine and carboxyl groups to observe the interaction of the PS NP surface charge and roots. With our work, the interactions nanoplastic particles have with plants can be further understood in terms of root adsorption and potential distribution and accumulation inside plants.

Toward Nanoscale Magnetofluorescence: Correlated AFM-Raman and Fluorescence Characterization of the Quantum-Sensitive Protein MagLOV

Patrick Foti, Beder Nourachi, Dmitri V. Voronine

MagLOV is an engineered variant of the Avena sativa LOV2 domain. Its flavin-based fluorescence is modulated by weak magnetic fields through a radical-pair mechanism. Recent work has shown that it supports optically detected magnetic resonance in living cells at room temperature (1). These effects have so far been characterized in cells and bulk samples. To our knowledge, no one has yet examined how MagLOV behaves at the nanoscale, or whether local fields from a probe tip can modulate its emission. Here, we use a hybrid AFM-Raman platform (Horiba XploRA Nano) to image MagLOV immobilized on nickel-agarose beads and record its emission under 488 nm and 532nm excitation. The observed emission peak near 535 nm agrees with published spectra. Repeated laser exposure caused visible bead degradation over two hours, which sets practical limits on illumination. Tip-sample distance force curves on bare substrate provide baselines for planned magnetic-tip (MFM) experiments aimed at single-molecule magnetoflorescence.

Reference:
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Femtosecond laser deposition of a carbonaceous chondrite regolith simulant onto glass

James Tedder, Leith Dessureault, Ilya Mingareev

Laser-induced deposition of metallic and non-metallic powders onto glass has shown promise for applications ranging from additive manufacturing and lab-on-chip fabrication to functional coatings and localized material joining. The extension of this regolith deposition method may also provide opportunities for extraterrestrial manufacturing and in-situ resource utilization (ISRU). This exploratory study investigates the deposition of a carbonaceous chondrite regolith simulant onto glass using high-repetition-rate femtosecond laser radiation as a localized heat source. The effects of several process parameters, including average laser power, focal position, translational speed, and separation between adjacent processing lines, on the morphology and consistency of the deposited tracks were investigated. The resulting deposits were characterized using optical microscopy and scanning electron microscopy (SEM) to evaluate their surface morphology, continuity, and overall deposition characteristics. The influence of individual processing parameters was examined systematically to identify the conditions which promoted continuous and uniform deposition. Under suitable processing conditions, consistent deposited layers with thicknesses of up to approximately 200 μm were reproducibly achieved. These observations provide a basis for further optimization of this deposition process and continued investigation of the resulting material-substrate interface.

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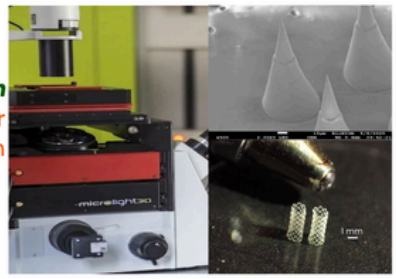
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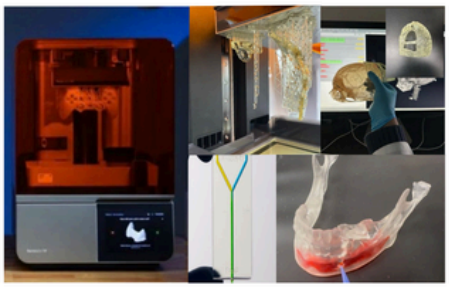
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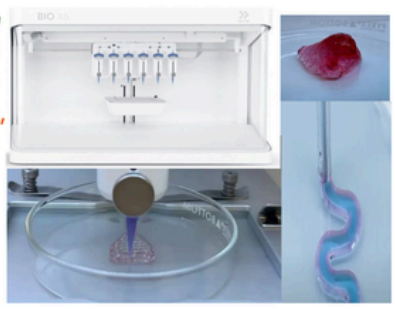
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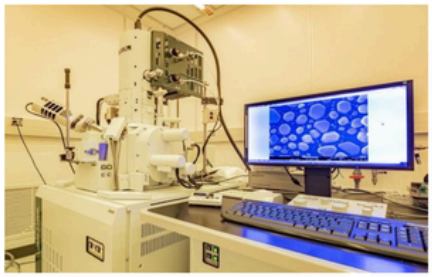


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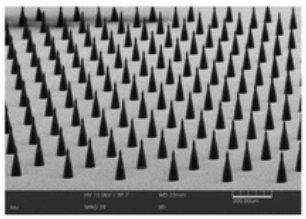
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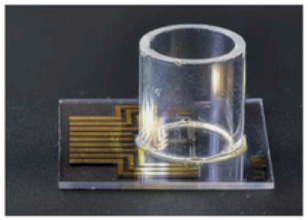
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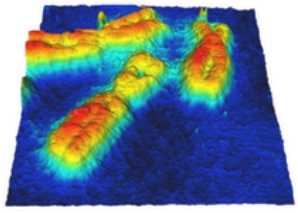
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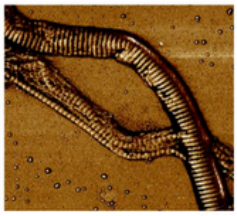
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Human Lymphocyte Chromosomes
Scan field 10 µm x 10 µm; z-range: 0-200 nm.
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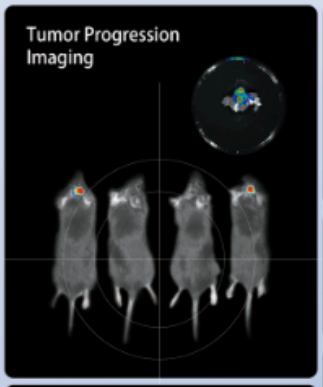


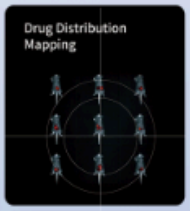


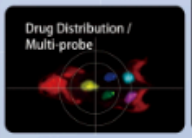
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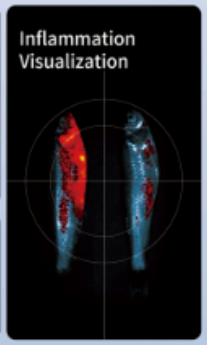
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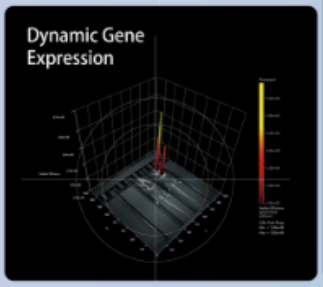
Dynamically monitoring tumor metastasis and drug distribution

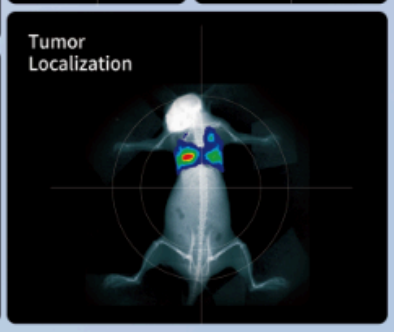


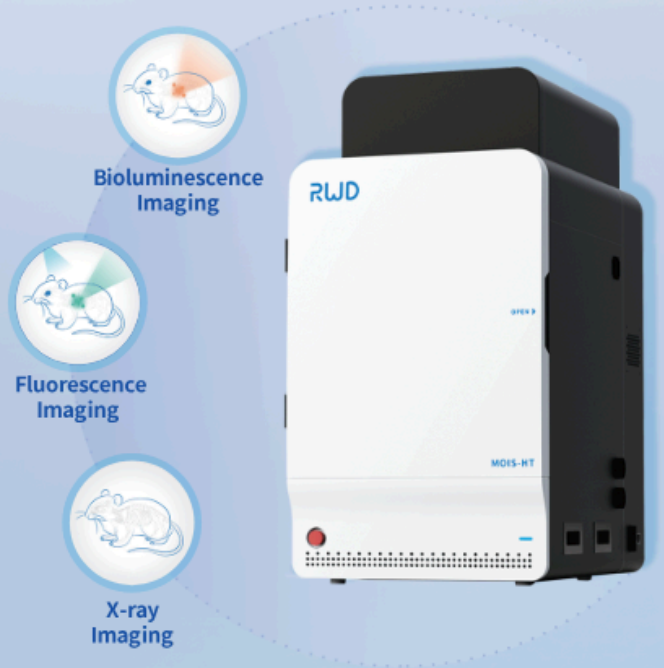












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133 Invention patent applications

140+ Countries and regions

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