Eighth Annual

BIOMATERIALS DAY

Celebrating Biomaterials InvestiGATORS

March 18, 2019

Hosted by the University of Florida Society for Biomaterials Student Chapter

Welcome to the University of Florida's Regional Biomaterials Day 2019!

On behalf of the Society for Biomaterials student chapter at the University of Florida, we would like to thank you for attending our 8th annual Biomaterials Day. This year's theme is "Celebrating Biomaterials InvestiGATORS" in the spirit of highlighting the amazing biomaterials work of our students, professors, and alumni. We are proud to host this one-day technical symposium to provide an interdisciplinary opportunity for students, faculty, and industry representatives to interact and discuss the newest and most exciting advances in the field of biomaterials. We thank you again for your support and hope to see you all again next year!

Regards,

Deanna Bousalis
Biomaterials Day Chair
UF SFB Vice President
dbousalis@ufl.edu

Jamie Murbach
UF SFB President
jam8744@ufl.edu

Syd Wiggins
UF SFB Treasurer
sydwiggins@ufl.edu

Matthew Becker
UF SFB External Affairs Coordinator
mbecker1@ufl.edu

Jennifer Simonovich
UF SFB Secretary
jsimonovich@ufl.edu

Bryan James
UF SFB Outreach Coordinator
bryan.james@ufl.edu

Sabrina Freeman
UF SFB Webmaster
slfreeman@ufl.edu

Dr. Anthony Brennan
UF SFB Faculty Advisor
abrennan@mse.ufl.edu

Biomaterials Day 2019

"Celebrating Biomaterials InvestiGATORS"
March 18, 2019
Reitz Union Grand Ballroom

Time	Event	Speakers
7:30-8:15 AM	Registration/Breakfast	-------
8:15-8:20 AM	Welcome Address	Dr. David Norton (VP for UF Research)
8:25-9:10 AM	Invited Speaker 1	Dr. Ashutosh Agarwal (UMiami)
9:15-10:00 AM	Invited Speaker 2	Dr. Chelsea Magin (UC, Anschutz)
10:05-10:20 AM	Coffee Break	--------
10:25-11:10 AM	Invited Speaker 3	Dr. Gulden Camci-Unal (UMass, Lowell)
11:15 AM-12 PM	Student Talks	Cameron Morley Olivia Lanier Isaac Adjei
12:00-1:30 PM	Lunch	-------
12:30-2:00 PM	Poster Session, Industry Meet and Greet	Student Presenters, Industry Reps
2:00-2:15 PM	Coffee Break	-------
2:15-3:00 PM	Student Talks	Adam Grippin Alexander McGhee Margaret Fettis
3:05-4:05 PM	Keynote Address	Dr. Christopher Batich (UF)
4:10-4:30 PM	Closing Remarks and Awards	Dr. Anthony Brennan (UF)

Acknowledgments

The Society for Biomaterials at UF would like to acknowledge our generous sponsors without whose support this event would not be possible. Their sponsorship allows us to keep this event completely free of charge to attendees, and to host speakers from across the country. We would also like to thank all the SFB student members and faculty who have helped make this event possible.

Sponsors include:
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Thank you to our poster and oral presentation judges:

Dr. Isaac Adjei
Dr. Kerim M. Gattas Asfura
Dr. Nora Hlavac
Dr. Gregory Hudalla
Dr. Renjie Liu
Dr. Jorge Mojica-Santiago
Dr. Lee Murfee
Dr. Ed Phelps
Dr. Blanka Sharma
Dr. Young Hye Song
Dr. Cherie Stabler
Dr. Whitney Stoppel
Dr. Arun Wanchoo

Also, big thanks to **Shannon Brown (PhD candidate, BME)** for designing our logo this year!!!

Keynote Address

Christopher Batich, Ph.D.
Professor, Department of Materials Science and Engineering
University of Florida

"Biomaterials Research and Development Opportunities and Challenges at UF"

Abstract:
The potential to enable better health care though the careful use of biomaterials is enormous. Many great theoretical designs and ideas fail because the right material was not available or not used. Some brief examples will be given including hip implants, intraocular lenses, and hemodialysis systems. However, finding the right material and bringing it to general patient care is a complex and challenging endeavor. This talk will cover some of the positive and negative experiences in this series of steps ranging from problem and solution identification to proof of principle to widespread testing and approval for use with human patients. Some of the excellent advantages of working at the University of Florida will be described as well as to some perceived places to further improve the process both locally and nationally. It is hoped that we can learn as much from unsuccessful projects as with successful ones.

Invited Speakers

Shannon Servoss, Ph.D.
Associate Professor, Department of Chemical Engineering
University of Arkansas

Although previously scheduled to speak, Dr. Servoss was not able to be here today for medical reasons. We encourage you to learn more about her work on self-assembled nanobiomaterials through her publications or website.

Ashutosh Agarwal, Ph.D.
Assistant Professor, Department of Biomedical Engineering
Associate Director, Macdonald Foundation Biomedical Nanotechnology Institute
University of Miami

"Organ on Chip Platforms for Modeling Human Disease"

Abstract:

We report the design and fabrication of robust fluidic platforms that are optimal for culturing and interrogating 3D organoid cultures. The optimized design of convective fluid flows, use of bio-inert and non-absorbent materials, reversible assembly of the platform, manual access for loading and unloading of cultures, and straightforward integration with commercial imaging and fluid handling systems are major improvements over conventional PDMS-based low volume microfluidics.

The platform has been used for perfusion interrogation of human pancreatic islets, and engineered spheroid cultures that mimic the metastatic niche of the bone marrow. Human pancreatic islets were tested for dynamic secretion of hormones, concomitant live-cell imaging, and optogenetic stimulation of genetically engineered islets. The efforts to evaluate ex vivo function of islets are informing the clinical trials currently underway to transplant human islets in Type 1 Diabetic patients.

The platform is also being tested for long term culture of spheroids composed of primary human cells of the bone marrow along with vascular cells and supporting pericytes. The efforts to recreate the metastatic niche are enabling in vitro maintenance and propagation of circulating tumor cells derived from the blood of breast and prostate cancer patients, as tools for enabling precision oncology.

Chelsea M. Magin, Ph.D.
Assistant Professor, Department of Medicine and Department of Bioengineering
University of Colorado, Anschutz Medical Campus

"Biomaterial Strategies for Modeling Human Pulmonary Diseases"

Abstract:

Chronic pulmonary diseases, including idiopathic pulmonary fibrosis (IPF), pulmonary hypertension (PH), and chronic obstructive pulmonary disease (COPD), account for staggering morbidity and mortality worldwide but have limited clinical management options available. Although great progress has been made to elucidate the cellular and molecular pathways underlying these diseases, a significant disparity remains between basic research endeavors and clinical outcomes. This discrepancy is due in part to the failure of many current disease models to recapitulate the dynamic changes that occur during pathogenesis in vivo. As a result, pulmonary medicine has recently experienced a rapid expansion in the application of engineering principles to characterize changes in human tissues *in vivo* and model the resulting pathogenic alterations *in vitro*. We envision that engineering strategies using precision biomaterials and advanced biomanufacturing will revolutionize current approaches to disease modeling and accelerate the development and validation of personalized therapies. This presentation highlights the advances our lab has made toward this goal. We have designed and developed dynamic, poly(ethylene glycol)-based hydrogels that can be 3D-printed and combined with a variety of cell types to recreate the complex structures observed within pulmonary tissues.

Gulden Camci-Unal, Ph.D.
Assistant Professor, Department of Chemical Engineering
University of Massachusetts, Lowell

"Engineered Biomaterials to Improve Human Health"

Abstract:

Regeneration of tissues damaged due to disease or trauma represents a major medical need. Although surgical replacement can be performed to address this issue, insufficient number of donors limits the applicability of the approach. There is, therefore, an unmet demand for development of tissue replacements. My research aims to control and modulate cellular behavior for directing repair and regeneration of tissues. To achieve this goal, I use diverse tools taken from chemistry, cell biology, materials science, and engineering. In my seminar, I will talk about new biomaterial platforms to generate multicellular and compartmentalized tissue-mimetics for clinical applications including endothelialization of cardiovascular tissues, regeneration of bone, and invasion of tumors. To overcome the limitations with the conventional methods, we have developed a novel layer-by-layer approach to assemble tissue-like structures. This strategy offers unique opportunities ranging from understanding fundamental biology to development of disease models for personalized medicine. The ultimate goal of my research is to improve human health and quality of life.

Oral Presentations

"Nanoparticle-mediated knockdown of TGFBR2 improves Natural killer cell cytotoxicity"

Isaac Adjei, Jahnelle Jordan, Nhan Tu, Thu Le Trinh, Sheng Wei, Blanka Sharma

Primary Author Department: J. Crayton Pruitt Department of Biomedical Engineering

Abstract: Solid tumors produce immunosuppressive factors that inhibit the function of NK cells. Here, we demonstrate nanoparticle (NP)-mediated knockdown of TGF-β receptor 2 (TGFBR2) to improve NK cell function. Cationic manganese dioxide NPs ($pMnO_2$-NP) that are15 nm complexed and protected siRNA from degradation. The $pMnO_2$-NP-mediated siRNA delivery to NK cells resulted in 90% knockdown of the TGFBR2 receptor without cytotoxicity. Significantly, TGFBR2 receptor knockdown restored NK cell infiltration and killing of lung cancer cells even in the presence of TGF-β1. Results from this study show the feasibility of increasing the resilience of NK cells to the immunosuppressive environments in solid tumors.

"A Chimeric, Multivalent Fusolectin of Galectin-1 and Galectin-3 with Enhanced Extracellular Activity"

Margaret M. Fettis, Shaheen A. Farhadi, and Gregory Hudalla

Primary Author Department: J. Crayton Pruitt Department of Biomedical Engineering

Abstract: Galectins are a diverse family of proteins capable of inducing cell death, modulating cell signaling, and directing cell trafficking by binding extracellular carbohydrates. In particular, Galectin-1(G1) has shown efficacy in many autoimmune and inflammatory disease animal models. However, frequent administration of high concentrations of G1 are required which challenges its translation to humans. Here, we developed and characterized the immunomodulatory activity of a galectin tetramer created by fusing and assembling Galectin-1 and Galectin-3 domains. We envision this galectin assembly will be a more potent T cell immunomodulatory therapeutic than previously reported G1 therapies.

"Bifunctional RNA nanoparticles induce antitumor immune responses and allow MRI-based detection of dendritic cell migration as a biomarker of antitumor immune response"

Adam J. Grippin, Brandon Wummer, Elias J. Sayour, Adam Monsalve, Kyle Dyson, Tyler Wildes, Jon Dobson and Duane A. Mitchell

Primary Author Department: J. Crayton Pruitt Department of Biomedical Engineering

Abstract: Cancer vaccines initiate profound antitumor responses in a subset of patients, but the lack of clinically meaningful biomarkers to predict treatment response limits their development. In this study, we design RNA-loaded magnetic liposomes that initiate potent antitumor immune responses and enable MRI-based prediction of treatment response. In preclinical tumor models, MRI-predicted "responders" identified two days after vaccination had significantly smaller tumors 2-5 weeks after treatment and lived 100% longer than MRI-predicted "non-responders." These studies therefore provide a simple, scalable nanoparticle formulation to generate robust antitumor immune responses and predict individual treatment outcome with MRI.

"Composite Microparticles for the Magnetically Triggered Delivery of Human Placental Proteins for Wound Healing"

Olivia Lanier, Joseph Ficarrotta, Isaac Adjei, Dayita Wable, Chris Nacea, Camryn Lewis, Laura Castillo, Blanka Sharma, Peter McFetridge, Jon Dobson

Primary Author Department: J. Crayton Pruitt Department of Biomedical Engineering

Abstract: The induction of vasculogenesis and angiogenesis *in vitro* and *in vivo* has been demonstrated in our lab using proteins derived from the human placenta (*h*PM). However, to maintain angiogenesis, *h*PM must be delivered in multiple boluses. The objective of this work is to develop a non-invasive, remotely triggered *h*PM delivery system that can adjust release to the patient's changing physiological requirements in wound healing applications. The proposed system consists of polycaprolactone microparticles encapsulating *h*PM and magnetic nanoparticles (MNPs). Release of *h*PM is triggered by

heat generated when the MNPs are exposed to an alternating magnetic field, which melts the polycaprolactone.

"Spatially Patterned T cell Communication near 3D Printed Tumors"

Cameron Morley, Ginger Moore, Catherine Flores, Duane Mitchell, Tommy Angelini

Primary Author Department: Mechanical and Aerospace Engineering

Abstract: Priming T cells with tumor RNA triggers an immune response that drives them toward the corresponding tumors. The efficacy of these treatments have been promising in the mouse model, however the fundamental driving mechanisms behind the T cells' targeting tumors is still being investigated. To study the spatiotemporal relationships between T cell populations and nearby tumors, we employ a method of 3D bioprinting into a bed of jammed microgels. With this capability, we can systematically study responses of the T cells to the tumor by printing radially symmetric Saturn-like structures of which the center is made of mouse glioma and the rings are made of T cells. Data on the temporal evolution of T cells targeting the tumor will be shown, in which biased motion toward the tumor correlates with a diffusion time for molecules to leave the tumor and trigger T cell targeting. This spatiotemporal relationship allows the determination of the cytokine diffusion coefficient.

"In situ 3D studies of cancer biology and immunotherapy"

A.J. Mcghee, E. O. McGhee, D.L. Hood, K.E. Van Meter, J.M. Urueña, P. P. Levings, W.G. Sawyer

Primary Author Department: Mechanical and Aerospace Engineering

Abstract: Fabrication of microtumors using 3D printing in Liquid Like Solids (LLS) made from assemblies of soft granular microgels facilitate precise arrangement of delicate and highly detailed assemblies of cells in designed microenvironments of extra-cellular matrix components and cells. A modular perfusion system that uses a negative pressure chamber to draw fluids containing nutrients, drugs, growth factors, and

metabolic waste through the LLS and 3D printed microenvironment enables long-term cell culture without disturbing the structure and position of the fabricated microtumoroid. Immuno-oncology studies were performed using activated cytotoxic T cells whos infiltration was tracked in the presence these patient derived, 3D cultured microtumoroids.

Poster Presentations

1. *Tuning the pKa of Poly(lysine): Enhancing Stimuli-Responsiveness of Peptide Block Copolymers*
   Abigail K. Nason, Brooke E. Barnes, Daniel A. Savin

2. *Tumor-homing RNA-nanoparticles reprogram immune cells in the brain tumor microenvironment*
   Adam Grippin, Brandon Wummer, Hector Mendez-Gomez, Tyler Wildes, Kyle Dyson, Jon Dobson, Elias Sayour, and Duane Mitchell

3. *Effect of Dopant on In Situ Polymerization of Poly(3,4-ethylenedioxythiophene) (PEDOT) in Central Nervous System*
   Adrienne E Widener, Jamie M Murbach, Kevin J Otto

4. *Attenuating Multiple Sclerosis in Mice with an Antigen-Specific Vaccine*
   Alexander Kwiatkowski, Joshua Stewart, Jonathan Cho, Theodore Drashansky, Eric Helm, Ashley Zuniga, Dorina Avram, and Benjamin Keselowsky

5. *Effects of PSS Molecular Weight on Conductivity of Electropolymerized PEDOT:PSS Wires for Neural Stimulation*
   Alyssa Massais, Scott Thourson, Jamie Murbach, Kevin Otto

6. *Electrical Stimulation of Adipose-derived Stem/Stromal Cells and Subsequent Secretome Characterization*
   Aria R. Henderson, Deanna Bousalis, Nicole A. Bohmann, Nora Hlavac, Erin Patrick, Sahba Mobini, Christine E. Schmidt

7. *Effect of Ethylene Oxide Sterilization on the Electrical Characteristics of Shape-Memory Polymer Nerve Cuff Electrodes*
   Brandon S. Badamtchian, Kaitlynn P. Olczak, Kevin J. Otto

8. *Synthesis and Characterization of Self-Assembling ABC Triblock Co-polypeptides*
   Brooke E. Barnes, Taylor A. Jenkins, Lauren M. Stein, Robert T. Mathers, Daniel A. Savin

9. *A Decoupled Multi-Stimulus Bioreactor for Studying Complex Chemo-Mechanical Microenvironments In Vitro*
   Bryan D. James, Nicholas Montoya, William Ruddick, Josephine B. Allen

10. *Development of S-nitroso-N-acetylpenicillamine (SNAP) Impregnated Medical Grade Polyvinyl Chloride for Antimicrobial Medical Device Interfaces*
    Corbin Feit, Manjyot Kaur Chug, Dr. Elizabeth Brisbois

11. *Characterization of IL-10 Surface Functionalization of Islet Analogs on Macrophage Polarization*
    Danielle Miller, Sydney Wiggins, Cherie Stabler

12. *Effects of the Human Placental Matrix and Culture Conditions on Chondrogenesis in Mesenchymal Stem Cells*
    Dayita Wable, Olivia Lanier, Adam Monsalve, Sridevi Conjeevaram, Jon Dobson, Peter McFetridge

13. *Examining Nerve Regeneration in an Implanted Peripheral Nerve Interface*
    F. Sedwick1, A. Czeiszperger, F. Garcia, E. Atkinson, B. Spearman, C. Kuliasha, A. Furniturewala, M. Yusufali, C. Schmidt, J. Judy, K.J. Otto

14. *Harnessing Strained Disulfides for Photocurable Dynamic Hydrogels*
    Georg M. Scheutz, Jonathan L. Rowell, Sarah T. Ellison, Thomas E. Angelini, and Brent S. Sumerlin

15. *Responses of spinal neural progenitor cells to chronic microstimulation*
    Malone IG, Dale EA, Joulaee Y, Nash MA, Natalie AS, Santana JP, Starr EE, Otto KJ, Reier PJ

16. *Engineering tunable growth factor and cytokine release rates from silk-extracellular matrix scaffolds to reduce scar formation and chronic inflammation following muscle injury*
    JF Jameson, JM Grasman, EC Bender, KM Clark, AM Espinoza, LD Black, III, DL Kaplan, and WL Stoppel

17. *Chronic evaluation of shape memory polymer nerve cuff electrodes*
    Kaitlynn P Olczak, Elliott Dirr, Francisco Delgado, Amanda Crider, Damon G Lamb, Andrew P Maurer, Sara N Burke, Barry Setlow,Jennifer L Bizon,Kevin J Otto

18. *Elvax 40W-Based GABA Delivery for Beta Cell Regeneration in Type-1 Diabetes*
    Kevin Ling, Mallika Bhatta, Matthew Becker, Robert Dolan, Edward Allen Phelps

19. *Iron oxide-loaded liposomes for effective RNA delivery and dendritic cell tracking*
    Mackenzie Grubb, Adam J. Grippin, Elias J. Sayour, Brandon Wummer, Adam Monsalve, Kyle Dyson, Tyler Wildes, Jon Dobson and Duane A. Mitchell

20. *Integration of antifouling and nitric oxide releasing-polymer for enhanced biocompatibility of insulin cannula*
    Manjyot Kaur Chug, Sean Hopkins, Jitendra Pant, Megan Douglass, Corbin Feit, Hitesh Handa, Elizabeth J Brisbois.

21. *Advanced Manufacturing for Biomedical Applications*
    Marc Sole Gras, Kaidong Song, Yong Huang

22. *Characterization of Injectable Chemically-Decellularized Peripheral Nerve Scaffolds*
    Vaughn NE, **McCrary MW**, Song YH, Morley C, Angelini TE, and Schmidt CE

23. *Electrochemical features and long-term stability of electrode-site geometry of intracortical neuroprostheses*
Veit N.C.; Urdaneta M.E.; Pattanshetti A. ; Peñaloza J.D. ; Otto K.J.

24. *Localized Release of Steroids from Macroporous Organosilicone Beads Scaffolds*
Jia-Pu Liang, **Robert Accolla**, Kaiyuan Jiang, Cherie Stabler

25. *Molecular Scale Modifications of Thiol-ene Networks for Enhanced Macroscopic Properties*
Scarlett Arencibia, Adriana Hernandez, Clayton Keene, Daniel Savin

26. Exosome single cell sequencing using 3D printing
Senthilkumar Duraivel, Thomas E Angelini

27. *Novel coating to enhance physical properties of a glass-ceramic veneer*
Hsu SM, Ren F, Chen Z, Kim MJ, Beers K, Clark AE, Neal D, Fares C, Esquivel-Upshaw JF

28. *Polypeptide Synthesis by Photopolymerization of NCAs*
Sofia L. Goodrich, Megan R. Hill, Rebecca A. Olson, Brent S. Sumerlin

29. *Iron oxide loaded liposomes enable early prediction of antitumor response with MRI*
Adam Grippin, Brandon Wummer, **Suraj Padala**, Mackenzie Grubb, Elias Sayour, Tyler Wildes, Kyle Dyson, Vrunda Trivedi, Hector Mendez-Gomez, Adam Monsalve, Jon Dobson, Duane Mitchell

30. *Optimizing the PEGylation of Stable Galectin-1 Dimers*
Bryant Kane, Margaret M. Fettis, Gregory Hudalla

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