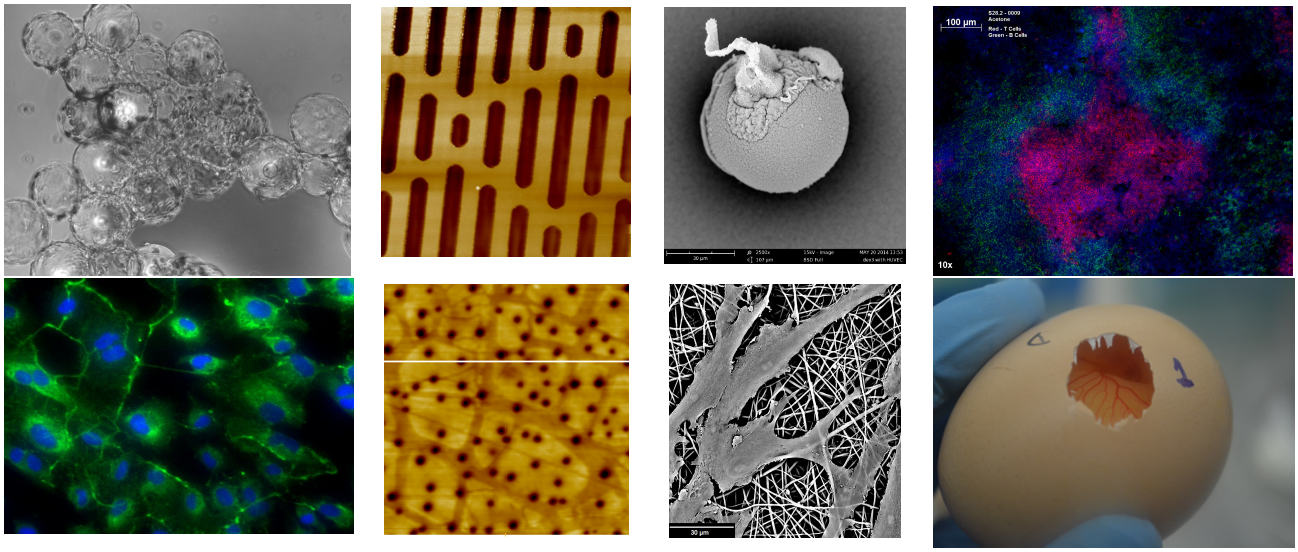
Society For Biomaterials

Giving life to a world of materials

Biomaterials Day 2017

Exploring the capabilities of Biomaterials

Hosted by the University of Florida Society for Biomaterials Student Chapter



Welcome to the University of Florida's Regional Biomaterials Day 2017!

On behalf of the Biomaterials Day Organizing Committee of the Society for Biomaterials, we would like to thank you for attending our sixth annual Biomaterials Day. This year's theme is "Exploring the capabilities of Biomaterials." The student chapter of the Society for Biomaterials at University of Florida is very proud to host this one day technical symposium and provide an opportunity for students, faculty members, and industry representatives from our region to interact and discuss some of the newest and most exciting advances in the field of Biomaterials. We hope to promote interdisciplinary interactions amongst all our attending guests.

Again, thank you for your support, and we hope you enjoy this exciting opportunity to learn about biomaterials and network with your colleagues and peers. We hope to receive your continued support and participation in the following years also.

Regards,

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Acknowledgments

The Biomaterials Day organizing committee would like to acknowledge our generous sponsors without whose support this event would not be possible. Their sponsorship allows us to offer this event completely free of charge, and organize enlightening and informative sessions and invite speakers from around the country to further enrich the event.

Sponsors include:

Society for Biomaterials National Chapter
University of Florida Department of Sponsored Research
University of Florida Department of Materials Science and Engineering
University of Florida J. Crayton Pruitt Department of Biomedical Engineering
Proctor and Gamble

We would also like to thank all the SFB student members and faculty who have helped make this event possible, including the student researchers at UF who have generously provided all the artwork and images seen in this program booklet.

We would like to acknowledge all of our Biomaterials Day volunteers: Sabrina Freeman, Valentina Garcia, Syd Wiggins, Kun Fang, Sayali Belsare, Jessi Rex, Yiwei Chen, Deanna Bousalis, Miles Gorman, Dongming Lyu, Monica Wall, Darcy Lichlyter, Dan Stewart, Michele Dill, Robert Dolan, and Taylor Repetto

Special thanks go to our industry partners and clubs for their involvement and continued contribution to Biomaterials Day and the Society for Biomaterials

Industry Partners include:

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Biomaterials Day 2017

"Exploring the Capabilities of Biomaterials"
March 31, 2017. 8:00 am- 4:00 pm
Reitz Union Grand Ballroom and Auditorium

Time	Event	Speakers		Area
8:00-9:00	Registration/ Breakfast	———————		Grand Ballroom
9:00-9:05	Welcome address	Dr. Christine Schmidt (UF)		Grand Ballroom
9:05-9:50	Invited Speaker 1	Dr. Douglas Weber (DARPA)		Grand Ballroom
9:50-10:35	Invited Speaker 2	Dr. Evan Scott (Northwestern)		Grand Ballroom
10:35-10:50	Snack/Coffee Break	———————		Grand Ballroom
10:50-11:35	Invited Speaker 3	Dr. Michele Manuel (UF)		Grand Ballroom
11:35-12:20	Student Presentations: Panel 1	11:35-11:50	Evelyn Bracho-Sanchez	Grand Ballroom
		11:50-12:05	S. Tori Ellison	
		12:05-12:20	Christopher O'Bryan	
12:20-1:00	Lunch	———————		Grand Ballroom
1:00-1:50	Student Poster Session	———————		Grand Ballroom
2:00-3:00	Keynote Address	Dr. Darrell Irvine (MIT)		Auditorium
3:00-3:45	Student Presentations: Panel 2	3:00-3:15	Cameron Morley	Auditorium
		3:15-3:30	Tapomoy Bhattacharjee	
		3:30-3:45	Aniruddha Kulkarni	
3:45-4:00	Closing Remarks and Awards	Dr. Anthony Brennan (UF, SFB Faculty Advisor)		Auditorium

Keynote Address Abstract

Darrell Irvine, Ph.D.
Professor of Materials Science and Engineering and Biological Engineering
Massachusetts Institute of Technology

Engineering immunity against cancer and infectious disease

Our laboratory focuses on applying principles from engineering and technologies from materials science, chemistry, and bioengineering to develop new approaches to study the immune system, create new diagnostics, and create next generation vaccines and cancer immunotherapies. Four vignettes of approaches we have explored spanning infectious disease, vaccines, and cancer immunotherapy will be presented: First, we will describe how small cell-penetrating nanoparticles can be used to concentrate antibiotics in lymph nodes to block lethal dissemination of bacteria. We will then discuss how the kinetics of antigen and inflammatory cues impact the immune response to vaccination, and describe studies employing microneedle skin patches that regulate vaccine timing to optimize the humoral response to HIV vaccines. We will then review two approaches to novel cancer immunotherapies: First, an approach to enhance adoptive cell therapy (ACT) for cancer will be described, combining nanomedicine with ACT via the chemical conjugation of drug-loaded nanoparticles (NPs) as synthetic “backpacks” to the surfaces of live lymphocytes for ACT. Finally, a novel strategy for targeting antigens and immunostimulatory agents to lymph nodes for therapeutic cancer vaccines will be described. Lymph node targeting is achieved clinically is sentinel lymph node mapping in cancer patients, where small-molecule dyes are efficiently delivered to lymph nodes by binding to serum albumin. To mimic this process in vaccine delivery, we synthesized amphiphiles designed to non-covalently bind vaccine antigens and adjuvants to endogenous albumin. These “albumin-hitchhiking” amphiphiles were efficiently delivered to lymph nodes following injection, leading to as much as 30-fold amplified cellular immune responses and anti-tumor immunity. These examples illustrate the power of bioengineering approaches in shaping the immune response and studying immune cell biology.

Invited Lectures Abstracts

Evan Scott, Ph.D.

Assistant Professor of Biomedical Engineering
Northwestern University

Engineering self-assembled nanobiomaterials for therapeutic immunomodulation

Self-assembled nanobiomaterials that are engineered to achieve specific biodistributions and mechanisms of degradation hold great promise for controlled stimulation of the immune system. Through the use of such rationally designed nanomaterials, we aim to investigate the basic inflammatory and immunological processes contributing to diverse pathologies and develop targeted immunotherapies. We specifically approach this by synthesizing, assembling and testing *in vitro* and *in vivo* a range of nanostructures loaded with strategically selected combinations of immunostimulants to achieve controlled elicitation or suppression of the immune system. Here, I will present some of our ongoing work in the areas of nanobiomaterials development, cardiovascular disease, and neonatal immunization.

Michele Manuel, Ph.D.

Chair of Materials Science and Engineering
University of Florida

Materials Design and Prototyping

Dr. Manuel is an internationally recognized leader and expert in light metals, design and computational methodologies for materials development, and materials characterization. She received her Ph.D. in Materials Science and Engineering at Northwestern University and her B.S. in Materials Science and Engineering at the University of Florida. Prior to her return to the University of Florida, she served as a post-doctoral researcher at General Motors in Warren, Michigan. She is the recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE), NSF CAREER, NASA Early Career Faculty, American Society of Metals (ASM) Bradley Stoughton, The Minerals, Metals and Materials Society (TMS) Early Career Faculty, TMS Young Leaders Professional Development, TMS and Japanese Institute for Metals (JIM) International Scholar, NASA Group Achievement, and the American Vacuum Society (AVS) Recognition for Excellence in Leadership awards. She currently serves on the TMS Board of Directors, director of the TMS Content Development and Dissemination committee, overseeing all TMS publications including: books and conference proceedings, the Journal of Metals, Metallurgical and Materials Transactions A, B, and E, Journal of Sustainable Metallurgy, Journal of Electronic Materials, and the Integrating Materials and Manufacturing Innovation journal publications. She is also the principal editor for the Journal of Materials

Research. Michele has served as a principal, senior, or co-investigator on over $25M in funding from a variety of federal, state, and industry sources on topics ranging from metallurgy to biotechnology to nuclear fuels. She has edited 5 books, published over 60 peer-reviewed journal publications, and contributed to over 100 technical presentations. She currently holds the Rolf E. Hummel Professorship of Materials Science and Engineering.

Douglas Weber, Ph.D.

Biological Technologies Office (BTO)
Program Manager at DARPA

Devices that connect with the nervous system to repair and enhance sensorimotor, autonomic, and cognitive functions

The rapid and exponential advances in micro- and nanotechnologies over the last decade have enabled technologies that communicate directly with the nervous system to measure and effect neural activity. Many of the earliest implementations focused on restoration of sensory and motor function, but as knowledge of physiology improves and technology continues to scale in resolution, precision, and even invasiveness, new modes such as engaging with the autonomic system herald an era of health restoration that may replace many pharmaceuticals. DARPA's Biological Technologies Office is continuing to push the boundaries of neurotechnology through programs investing in neural interfaces that are effective, reliable, and safe enough for long-term use in humans. DARPA's Hand Proprioception and Touch Interfaces (HAPTIX) program is working to create a fully implantable system that interfaces with peripheral nerves in amputees to enable natural control and sensation for prosthetic limbs. Advancing the neural interface technologies beyond standard electrode implementations, the Electrical Prescriptions (ElectRx) program is investing in innovative approaches to engaging with the peripheral nervous system in minimally-to-noninvasive ways such as through the advent of novel magnetic, optogenetic, and ultrasound-based technologies. In each instance, these new mechanisms of interrogating and stimulating the peripheral nervous system are driving towards unparalleled spatiotemporal resolution, specificity and targeting, and noninvasiveness with the expectation of moving towards chronic, human-use applications in closed-loop neuromodulation for the treatment of disease. Peripheral neuromodulation strategies may also provide opportunities to enhance cognitive functions in healthy individuals. DARPA's Targeted Neuroplasticity Training (TNT) program seeks to advance the pace and effectiveness of cognitive skills training through the precise activation of peripheral nerves that can in turn promote and strengthen neuronal connections in the brain. Each of these programs focus on achieving a mechanistic understanding of the neural circuits underlying the targeted functions, establishing a foundation for building technology that interfaces precisely and reliably with those circuits to restore or enhance functions.

Student Oral Presentations

Evelyn Bracho-Sanchez
Graduate student
J. Crayton Pruit Family Department of Biomedical Engineering
University of Florida

Targeted Extracellular Indoleamine 2,3-Dioxygenase Suppresses Immune Responses In Vitro and In Vivo

Evelyn Bracho-Sanchez, Azadeh Hassanzadeh, Kevin Y. Koenders, Antonietta Restuccia, Margaret M. Fettis, Mark A. Wallet, Gregory A. Hudalla, Benjamin G. Keselowsky.

Indoleamine 2,3-dioxygenase (IDO), an enzyme that catalyzes the rate limiting step of tryptophan catabolism, has been shown to play a critical role in the promotion of immune tolerance in pregnancy, cancer and transplant models1. Two mechanisms have been proposed for this effect: 1) depletion of this essential amino acid increases susceptibility of T cells to death by starvation, and 2) downstream metabolites, collectively known as kynurenines, directly interact with immune cells to induce anergy, apoptosis or halt proliferation of effector T cells by inducing regulatory T cells. Therefore, much interest has developed for the use of IDO to direct immune metabolism and induce a tolerogenic environment. IDO is preferentially expressed in the cytosol of antigen presenting cells and most efforts have focused on inducing expression of the enzyme by dendritic cells (DCs) and macrophages (MØs) 2. In this study we aim to establish IDO as a potent extracellular immunomodulator and develop a strategy for its targeted delivery in vivo by fusion with Galectin 3 (Gal3). Gal3 is a member of the carbohydrate binding lectin family, with strong affinity for N-Acetyl-D-lactosamine present in proteins of the extracellular matrix and surface receptors on various immune cells3.C80/86/MHC II evaluation and cytokine release profile revealed an immature DC phenotype was maintained when treated with extracellular IDO even in the presence of LPS. Suppression of antigen specific proliferation by IDO-treated DCs was also observed. This effect was reversed in the presence of MT suggesting suppression is mediated by the active enzyme. NanoLuc-Gal3 demonstrated retention at the injection site for up to 7 days post treatment with minimal localization to other organs and tissues. Following assessment of Gal3 as a retention strategy, evaluation of inflammatory cytokine gene expression in response to IDO-Gal3 revealed significantly reduced levels out to 5 days post-treatment. In this study we have established IDO as a potent extracellular immunomodulator capable of maintaining immature DCs and suppressing antigen specific proliferation in vitro. We have also designed an in vivo targeted delivery mechanism which allows for the localization of active enzymes up to 7 days at the injection site by fusion with Gal3. Treatment with fusion construct, IDO-Gal3, is able to modulate localized metabolism and significantly decrease inflammatory cytokine gene expression upon challenge with LPS.

Christopher S. O'Bryan
Graduate student
Department of Mechanical & Aerospace Engineering
University of Florida

Epithelial Cells at the Air-Gel Interface

Christopher S. O'Bryan; Tristan Hormel; Tapomoy Bhattacharjee; Thomas E. Angelini

Telomerase-immortalized human corneal epithelial cells (hTCEpi) grown at the air interface share many of the characteristics of human corneal epithelium in vivo, including stratification and apoptotic cell death of surface cells. Traditional methods of culturing epithelial cells at the air interface, including air-lifted cultures and hanging drops, limit the ability to image and physically interact with cells at the air-interface, preventing systematic in vitro studies. Recent work has shown that jammed granular microgels, with tunable mechanical properties, are capable of supporting cell growth. In this study, we investigate the growth of hTCEpi cells at the air-gel interface and explore their long term viability.

Tapomoy Bhattacharjee
Graduate student
Department of Mechanical & Aerospace Engineering
University of Florida

3D Cell Motion in Jammed Granular Microgels

Tapomoy Bhattacharjee, W. Gregory Sawyer, and Thomas E. Angelini

Soft granular polyelectrolyte microgels swell in liquid cell growth media to form a continuous elastic solid that can easily transition between solid to fluid state under a low shear stress. Such Liquid-like solids (LLS) have recently been used to create 3D cellular constructs as well as to support, culture and harvest cells in 3D. Current understanding of cell migration mechanics in 3D was established from experiments performed in natural and synthetic polymer networks. Spatial variation in network structure and the transience of degradable gels limit their usefulness in quantitative cell mechanics studies. By contrast, LLS growth media approximates a homogeneous continuum, enabling tractable cell mechanics measurements to be performed in 3D. Here, we introduce a process to understand and classify cytotoxic T cell motion in 3D by studying cellular motility in LLS media. General classification of T cell motion can be achieved with a very traditional statistical approach: the cell's mean squared displacement (MSD) as a function of delay time. We will also use Langevin approaches combined with the constitutive equations of the LLS medium to predict the statistics of T cell motion.

Aniruddha Kulkarni
Graduate student
Department of Chemical Engineering
University of Florida

Sensitive Colorimetric Detection of Nitrite Ions Based on the Aggregation of Gold Nanoparticles

A. Kulkarni, V. Bird and K. J. Ziegler

Determination of nitrite both environmentally and in life processes has been of importance as its presence above a threshold causes detrimental effects. Hence, there is a need to develop new, simple and highly sensitive analytical assays. Nitrite detection has been achieved through various methods, including chemiluminescence, electrochemistry, and surface-enhanced Raman scattering which involve use of expensive equipments, tedious procedures and time consumption.However, colorimetric assays can provide visual, on-site analysis, providing a simple and instantaneous detection method. In this work, a facile colorimetic assay has been proposed based on anti-aggregation of gold nanoparticles. Gold nanoparticles coated with aromatic amines react with nitrite ions that alter the aggregation state of the nanoparticles. The change to the aggregation state causes a shift in the local surface plasmon resonance bands, triggering a colorimetric response. An increase in the concentration of nitrite ions changes the color of the solution, which can be detected by the naked eye. While many approaches have used thiol-based linkers, our use of disulphide cross-linkers, which bind more strongly to gold has increased the sensitivity of detection by an order of magnitude. Furthermore, the effect of this assay on synthetic urine has been explored to understand the effect of the presence of foreign ions on the detection of nitrite.

Cameron Morley
Graduate student
Department of Mechanical & Aerospace Engineering
University of Florida

Contractile motion of cells in jammed microgels

Cameron Morley, S. Tori Ellison, Tapomoy Bhattacharjee, W.G. Sawyer and T.E. Angelini

Cells are often dispersed in extracellular matrix (ECM) gels like collagen and Matrigel as minimal tissue models. Generally, large-scale contraction of these constructs is observed, in which the degree of contraction and compaction of the entire system correlates with cell density and ECM concentration. The freedom to perform diverse mechanical experiments on these contracting constructs is limited by the challenges of handling and supporting these delicate samples. Here, we present a method to create simple cell-ECM constructs that can be manipulated with significantly reduced experimental limitations. We 3D print mixtures of MCF10A cells and ECM (collagen-I and Matrigel) into a 3D growth medium made from jammed microgels. With this approach, we are able to apply shear stresses to the cell constructs at arbitrary times after printing and observe the collective response. Our preliminary results reveal that, following shear deformations that exceed 300% and dramatically smear cells and matrix in space, the cells actively re-contract and re-compact the construct toward the original, un-sheared construct. These results suggest that new principles of collective recovery can be employed for tissue engineering applications using jammed microgels as a re-configurable support medium.

S. Tori Ellison
Graduate student
Department of Mechanical & Aerospace Engineering
University of Florida

Collective cell behavior on basement membranes floating in space

S. Tori Ellison, Cameron Morley, Tapomoy Bhattacharjee, and T.E. Angelini

The basement membrane is an essential part of the polarity of endothelial and epithelial tissues. In tissue culture and organ-on-chip devices, monolayer polarity can be established by coating flat surfaces with extracellular matrix proteins and tuning the trans-substrate permeability. In epithelial 3D culture, spheroids spontaneously establish inside-out polarity, morphing into hollow shell-like structures called acini, generating their own basement membrane on the inner radius of the shell. However, 3D culture approaches generally lack the high degree of control provided by the 2D culture plate or organ-on-chip devices, making it difficult to create more faithful in vitro tissue models with complex surface curvature and morphology. Here we present a method for 3D printing complex basement membranes covered in cells. We 3D print collagen-I and Matrigel into a 3D growth medium made from jammed microgels. This soft, yielding material allows extracellular matrix to be formed as complex surfaces and shapes, floating in space. We then distribute MCF10A epithelial cells across the polymerized surface. We envision employing this strategy to study 3D collective cell behavior in numerous model tissue layers, beyond this simple epithelial model.

Student Poster Presentations

1. Primary Author: Camilla Edwards
Title: PEG- Peptide Microparticles for use in Pulmonary Drug Delivery
Principle Investigator: Jennifer Andrew
Department: Materials Science and Engineering

2. Primary Author: R. Nicholas Carmean
Title: Ultrahigh Molecular Weight Polymer Synthesis to Strengthen Soft Materials
Principle Investigator: Brent Sumerlin
Department: Chemistry

3. Primary Author: Christopher Kabb
Title: Reversible-covalent hydrogels linked by photosensitive coumarin dimers
Principle Investigator: Brent Sumerlin
Department: Chemistry

4. Primary Author: Taylor Repetto
Title: A Novel Tri-Component Polymeric Electrospun Scaffold for Vascular Tissue Engineering
Principle Investigator: Josephine Allen
Department: Materials Science and Engineering

5. Primary Author: Shaheen Farhadi
Title: Localized biocatalysis via self-assembled enzyme-galectin fusions
Principle Investigator: Gregory Hudalla
Department: Biomedical Engineering

6. Primary Author: Sabrina Freeman
Title: Galectin 3 as a Retention Strategy for Delivery of Proteins to Multiple Sites In Vivo
Principle Investigator: Benjamin G. Keselowsky
Department: Biomedical Engineering

7. Primary Author: Daniel Stewart
Title: Super-soft lithography of polyacrylamide microchannels for maturation of myotubes
Principle Investigator: Chelsey S.Simmons
Department: Biomedical Engineering

8. Primary Author: Ashley Compaan
Title: Silk Fibroin Bioink for Printing Three-Dimensional Cell-Laden Constructs
Principle Investigator: Yong Huang
Department: Materials Science and Engineering

9. Primary Author: Krista Dulany
Title: Fabrication of a Free Radical Scavenging Nanocomposite Scaffold for Bone Tissue Regeneration
Principle Investigator: Josephine Allen
Department: Materials Science and Engineering

10. Primary Author: Pei-Ying Wu
Title: Aspiration-assisted end-cut coaxial biopsy needles
Principle Investigator: Hitomi Yamaguchi Greenslet
Department: Mechanical and Aerospace Engineering

11. Primary Author: Adam Grippin
Title: Reducing RNA-NP charge increases distribution toward lymphoid organs and enhances antitumor immunity
Principle Investigator: Duane Mitchell
Department: Biomedical Engineering

12. Primary Author: Wisam Fares
Title: Pancreatic Tumor Associated Stromal Cells on Polyacrylamide Hydrogels
Principle Investigator: Chelsey S. Simmons
Department: Biomedical Engineering

13. Primary Author: Kaitlynn Olczak
Title: Electrical Analysis of Minocycline Eluting Layer-By-Layer Thin-Films from Functional Micro-Electrode Arrays
Principle Investigator: Kevin J. Otto
Department: Biomedical Engineering

14. Primary Author: Josh Stewart
Title: A Dual-Microparticle System Prevents and Reverses Type 1 Diabetes in Non-Obese Diabetic Mice
Principle Investigator: Benjamin Keselowsky
Department: Biomedical Engineering

15. Primary Author: Michaela Mertz
Title: Balancing Cell Removal and Preservation of Intricate ECM Microstructures During Chemical Decellularization of Peripheral Nerve
Principle Investigator: Christine Schmidt
Department: Biomedical Engineering

16. Primary Author: Madison Temples
Title: 3D tumor model to recapitulate tumor microenvironment to evaluate interactions with natural killer cells
Principle Investigator: Blanka Sharma
Department: Biomedical Engineering

17. Primary Author: Seth Currlin
Title: The Implantable Multimodal Peripheral Recording and Stimulation System (IMPRESS)
Principle Investigator: Kevin. J. Otto
Department: Neuroscience, Biomedical Engineering

18. Primary Author: Nicholas Abuid
Title: Engineering Ultrathin, Antioxidant coatings for immunoprotection of transplanted Islets
Principle Investigator: Cherie Stabler
Department: Biomedical Engineering

19. Primary Author: Paritosh Rustogi
Title: Design and Fabrication of a Scalable Tissue-Engineered Electronic Nerve Interface (TEENI)
Principle Investigator: Jack Judy
Department: Mechanical and Aerospace Engineering

20. Primary Author: Deanna Bousalis
Title: Engineering Tissue Mimics to Investigate Congenital Heart Disease
Principle Investigator: Christine Schmidt
Department: Biomedical Engineering

21. Primary Author: James Graham
Title: Histological Evaluation of Chronically Implanted Tissue-Engineered-Electronic-Neural-Interface (TEENI) Devices
Principle Investigator: Kevin.J.Otto
Department: Bioengineering

22. Primary Author: Eric Atkinson
Title: Whole-tissue histological analysis of a tissue-engineered electrical nerve interface (TEENI) using CLARITY and advanced imaging techniques.
Principle Investigator: Kevin. J. Otto
Department: Neuroscience

23. Primary Author: Ishita Singh
Title: Magnetically templated hydrogels for peripheral nerve injury repair
Principle Investigator: Carlos Rinaldi
Department: Chemical Engineering

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Interested in getting more involved with UF SFB?

Nominate yourself for an officer position!
Officer Elections will be April 12 at 5:30 pm in Rhines 125.
We are looking for nominations for Vice President, Secretary, Treasurer, BEC Rep/Outreach Coordinator, Webmaster and External Affairs Coordinator

Descriptions:
https://goo.gl/MotyCQ

Nominations:
https://goo.gl/rlfSmp

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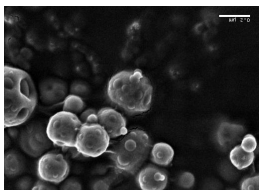
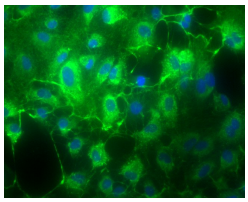
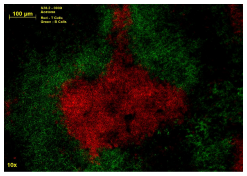
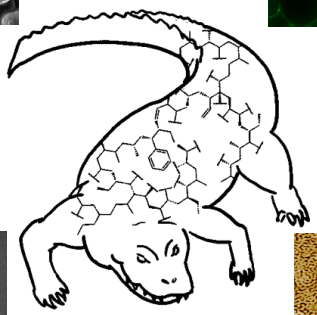
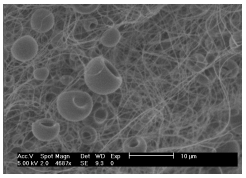
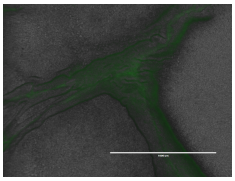
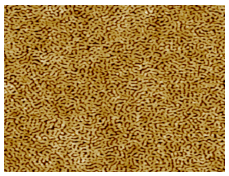
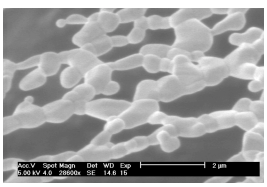
P&G

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