Biomaterials Day 2019 at the University of Florida

Celebrating Biomaterials InvestiGATORS

March 18, 2019

The student chapter of the Society for Biomaterials at the University of Florida held its eighth annual Biomaterials Day entitled "Exploring the Capabilities of Biomaterials" on March 18th, 2019 in the Reitz Union Grand Ballroom, Gainesville, FL. The one-day symposium consisted of a keynote address, oral presentations from both faculty and students, a student poster session featuring the work of postdocs and graduate and undergraduate students, and an industry tabling session. The following report will highlight the purpose of Biomaterials Day, attendees, sponsors, speakers, feedback, and success stories throughout the event.

Purpose of the event: Biomaterials Day provides an interdepartmental environment to discuss current biomaterial research through internal and distinguished external guest speakers, industry representatives, student poster sessions, and student presentations. Foremost, Biomaterials Day at UF serves to enlighten a wide array of students about what biomaterials have to offer them and the potential career paths and other opportunities in both industry and academia. Secondly, the event was used to expand the biomaterials network at UF with other students and companies actively involved in the biomaterials field. Our event achieved this goal by bringing professors from different universities and representatives from biotechnology companies to discuss advances in biomaterials in the engineering and medical fields. This year we also had students from other institutions across the state, such as University of Central Florida and Florida State University, attend Biomaterials Day. The UF student chapter of SFB focused on promoting the interaction between students, leading scientists, and developers in order to move the field forward.

Participants: Biomaterials Day 2019 had a total of 211 registered attendees including students, professors, and industrial professionals. The majority of attendees were from different departments including: Materials Science and Engineering, Biomedical Engineering, Mechanical and Aerospace Engineering, Chemical Engineering, Agricultural and Biological Engineering, Chemical Engineering, Neuroscience, Computer Science and Engineering, Civil Engineering, Chemistry, Biology, Molecular Genetics & Microbiology, and Pathology-Immunology. In addition, academic presentations were given by representatives from University of Miami, University of Massachusetts-Lowell, University of Colorado, and University of Florida. Industry representatives included participants from Exactech, Amend Surgical, Rheolution, Anton Paar, and Tucker-Davis Technologies.

Sponsors: Sponsors for Biomaterials 2019 included: the National Society for Biomaterials, UF Office of Research, UF Department of Materials Science and Engineering, UF J. Crayton Pruitt Family Department of Biomedical Engineering, Benton Engineering Council, UF Nanoscience Institute for Medical and Engineering Technology (NIMET), UF Department of Chemical Engineering, UF Department of Mechanical and Aerospace Engineering, Anton Paar, Rheolution, Tucker-Davis Technologies, and Amend Surgical.

Event Highlights: The symposium was kicked off by a welcome address given by Dr. David Norton, the Vice President of UF Research. The day consisted of a keynote address given by Dr. Chris Batich from the University of Florida entitled “Biomaterials Research and Development Opportunities and Challenges at UF,” and three talks given by faculty and researchers in the biomaterials field. We also had six student presentations given by Ph.D. students in Mechanical and Aerospace Engineering and Biomedical Engineering. The event also featured a student poster presentation competition with 30 presenters, and an industry information session with industry representatives from Rheolution, Anton Paar, Amend Surgical, and Exactech. We served breakfast, lunch, and coffee/snack breaks to all registered guests. In addition, all registered attendees received goodie bags containing a wide variety of informational pamphlets, the event’s program, an SFB Biomaterials Day t-shirt designed by SFB students, and free student membership promotional codes from the SFB National Chapter.

Speakers: The following speakers gave presentations during Biomaterials Day.

- Dr. Christopher Batich, University of Florida, “Biomaterials Research and Development Opportunities at UF”
- Dr. Ashutosh Agarwal, University of Miami, “Organ on Chip Platforms for Modeling Human Disease”
- Dr. Chelsea Magin, University of Colorado, Anschutz Medical Campus, “Biomaterials Strategies for Modeling Human Pulmonary Diseases”
- Dr. Gulden Camci-Unal, University of Massachusetts, Lowell, “Engineered Biomaterials to Improve Human Health”
- Dr. Shannon Servoss from the University of Arkansas was originally scheduled to present, but could not attend for medical reasons.

Student Presentations: Six graduate students competed in our student oral presentation competition. Each student prepared and presented a 15-minute oral presentation. Each presentation was judged on various categories including academic merit, presentation quality, and presentation delivery. Adam Grippin, a Graduate student from the Department of Biomedical Engineering, with a presentation titled “Bifunctional RNA nanoparticles induce antitumor immune responses and allow MRI-based detection of dendritic cell migration as a biomarker of antitumor immune response” won the best student presentation award. He presented his talk during the symposium and was awarded with a plaque. 30 students composed of undergraduate and graduate students, as well as postdocs, presented their research at the poster session. Nicole Veit, an undergraduate student in UF Biomedical Engineering, won best poster presentation, as judged by UF faculty, and was awarded with a plaque.

Success Story: We feel that the biggest success of Biomaterials Day 2019 was the increase in overall involvement and interest in biomaterials that we have seen over the past eight years. Our first Biomaterials Day in 2012 brought in a little over 70 participants and consisted of speakers primarily from UF. We have seen participation in our event consistently grow each year. We have also grown enough, and gathered enough sponsorship, to be able to bring in three amazing speakers (initially planned for 4, but one had a medical emergency and had to drop out) from across the country to inspire and invigorate our student attendees. Both student and invited

speaker presentations were well attended, and it was rewarding to see students engaged in the sessions.

Notes on UF SFB membership for 2018-2019: Following Biomaterials day, UF SFB's mailing list swelled to 674 total subscribers. Our organization also saw a sharp increase in women attendance and involvement. The majority of the executive board this year consisted of women! Our outgoing Vice President, Deanna Bousalis, was recently elected president-elect of the national student chapter of the Society for Biomaterials, and our outgoing Webmaster, Sabrina Freeman, was elected as the Secretary/Treasurer elect of the national student chapter. Additionally, within the last few years, our organization has expanded to include other departments such as Mechanical Engineering, Chemical Engineering, Chemistry, and Biomedical Sciences (Immunology and Pathology). Additionally, our organization tends to gather more involvement from graduate students, however we have recruited many active undergraduate members, and 2/7 positions of the incoming executive board have been filled by undergraduates.

Feedback: We were successful in attracting over 200 participants for our eighth annual Biomaterials Day at the University of Florida. We were able to attract a diverse attendee list because our invited speakers included different and interdepartmental types of biomaterial researchers. In a feedback survey sent to attendees, there was extremely positive feedback. Overall, people were satisfied with the event and commented on how the event has grown and improved over the years. Several faculty members commented on how impressed they were with such a large-scale event that was organized by SFB student officers. Some criticisms included that the event started too early (8 AM), that it conflicted with class schedules, and that timing of speakers was off. Some of these things were out of our control. For example, one student presenter fell ill and did not show up to his presentation, so we called an impromptu coffee/snack networking break. Additionally, we had originally planned for 5 invited speakers, hence why we began the event so early, however after Dr. Servoss cancelled due to medical reasons, we were forced to stretch out the schedule. Additionally, although it is impossible to have zero class conflicts with our event, we will do our best to reserve the event space on a Friday, when the least amount of classes are held on UF campus. Finally, although we hosted an industry portion at our event, we feel that we can do a better job of recruiting companies to attend. We would like to be able to provide more diverse employment opportunities for every SFB member. We will keep contact with the current companies that have helped us, and we plan to build new relationships with additional companies over the next year. Our goal for Biomaterials Day 2019 is to have over 250 registered attendees and increase our industrial partners. Based on the feedback we received, next year we will likely start our event later in the morning, at 9 AM, to increase attendance for the first few presentations.

Contact Information: The following people and their contact information were involved in the planning of Biomaterials Day.

- Deanna Bousalis, UF SFB Vice President, National President-Elect, dbousalis@ufl.edu
- Jamie Murbach, UF SFB President, jam8744@ufl.edu
- Sydney Wiggins, UF SFB Treasurer, sydwiggins@ufl.edu
- Jennifer Simonovich, UF SFB Secretary, jsimonovich@ufl.edu

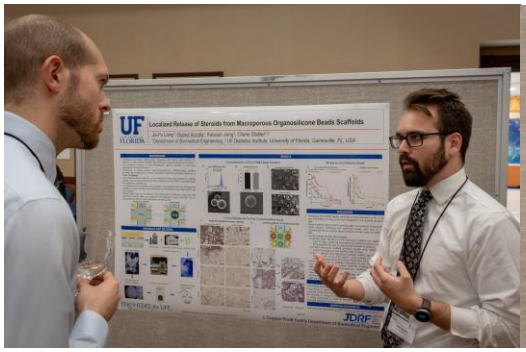
- Matthew Becker, UF SFB External Affairs Chair, mbecker1@ufl.edu
- Bryan James, UF SFB Outreach Chair, bryan.james@ufl.edu
- Sabrina Freeman, UF SFB Webmaster, National Treasurer/Secretary-Elect, slfreeman@ufl.edu
- Dr. Anthony Brennan, UF SFB Faculty Chair, abrennan@mse.ufl.edu

I would like to take this opportunity to thank the Society for Biomaterials for making this event possible. Without the society's generosity, Biomaterials Day would not be possible. Thank you for your continuous support of the University of Florida chapter!

Report compiled by Deanna Bousalis

PHOTOS:


UF UNIVERSITY of FLORIDA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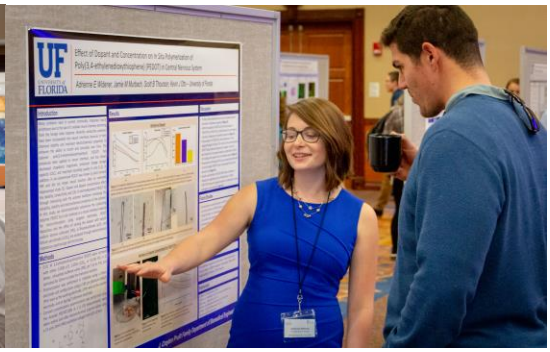
Localized Release of Steroids from Macroporous Organosilicone Beads Scaffolds
JDRF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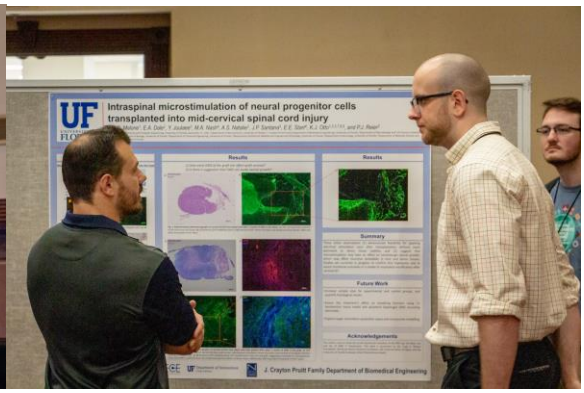
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Intraspinal microstimulation of neural progenitor cells transplanted into mid-cervical spinal cord injury
Results
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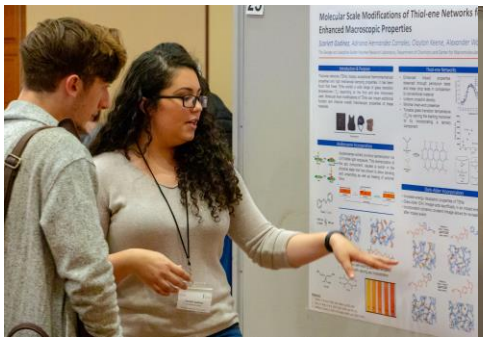
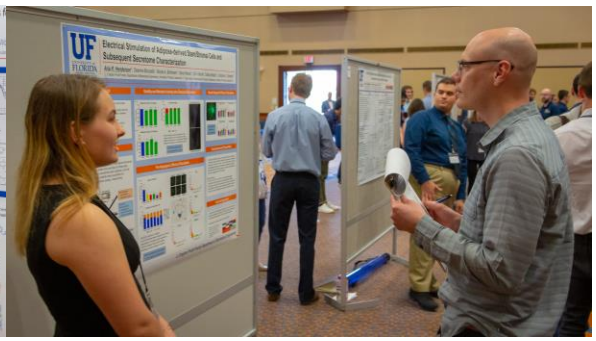
Summary
Future Work
Acknowledgements
J. Crayton Pruitt Family Department of Biomedical Engineering


List of Registered Attendees:

1	Jennifer	Van Deven
2	Young Hye	Song
3	Tolu	Ajayi
4	Aniruddha	Kulkarni
5	Kevin	Ling
6	Adrienne	Widener
7	Jamie	Murbach
8	Dillon	Seroski
9	Syd	Wiggins

10	Nida	Anwar
11	Chandler	Honaman
12	Maria	Perez
13	Cary	Kuliasha
14	David	Hagan
15	Deanna	Bousalis
16	Kerim	Gattas Asfura
17	Ruwen	Tan
18	Matt	Becker
19	Alecsa	Pereira
20	Sarah	Suttlemyre
21	Renjie	Liu
22	Marco	Melgar
23	Maggie	Fettis
24	Mythreyi	Unni
25	Jorge	Santini
26	Seth	Currlin
27	Elliott	Dirr
28	Ryan	Gamberino
29	Senthilkumar	Duraivel
30	Sruthi	Selvakumar
31	Yi	Wei
32	Shannon	Brown
33	Daniel	Stewart
34	Vishal	Vignesh
35	Nicholas	Abuid
36	Camille	Hernandez
37	Jaya	Kolli
38	Spencer	Serrano
39	Anne	Gormaley
40	Paulo	Ferreira
41	Shreedevi	Kumar

42	Madison	Temples
43	Aritra	Kundu
44	Khushboo	Undavia
45	Bryan	James
46	Aaron	Choi
47	Sophia	Saenz
48	Ritwika	Pal
49	Ashma	Sharma
50	Tran	Ngo
51	Magdalena	Samojlik
52	Nora	Hlavac
53	Jiejie	Lyu
54	Chen	Liang
55	Pedro	Rodriguez
56	Christopher	Nacea
~~57~~	Matthew	Molinaro
58	Eric	Fuller
59	Rishabh	Shah
60	Yong	Huang
61	Alexander	Knapp
~~62~~	Isaac	Adjei
63	Olivia	Liseth
64	Riley	Bassett
65	Erin	Van Dorn
66	Kristi	Folden
67	Lei	Wang
68	Jennifer	Simonovich
69	Marc	Sole Gras
70	Gantt	Meredith
71	Sean Marlon	Te
72	Sruthika	Baviriseaty
73	Felicia	Sedwick

74	Kaidong	Song
75	Adam	Grippin
76	Andres	Pulido
77	Michaela	McCrary
78	Mackenzie	Grubb
79	Arun	Wanchoo
80	Alexander	Kwiatkowski
81	Anthony	Gruber II
82	Robert	Accolla
83	Shu-Min	Hsu
84	Annika	Dasher
85	Patrick	Lim
86	Aria	Henderson
87	Isabella	Young
88	Sofia	Goodrich
89	Elizabeth	Brisbois
90	Julie	Jameson
91	Ryan	Hardy
92	Nicole	Veit
93	Nicole	Sieling-Mondora
94	Jake	Bloom
95	Brandon	Badamtchian
96	Smit	Patel
97	Saumadritaa	Kar
98	Cameron	Morley
99	Eric	Hill
100	Zhongming	Ma
101	Weichen	Gan
102	Hui	Zhou
103	Michael	Chang
104	Ariana	Suarez
105	Chris	O'Bryan

106	Mary	Kasper
107	Kari	Ross
108	Elisa	Nieves
109	Corbin	Feit
110	Danielle	Miller
111	Manjyot Kaur	Chug
112	Alexander	Mcghee
113	Olivia	Lanier
114	Jaxton	Willman
115	Caroline	Kelly
116	Mark	Maynes
117	Dan	LaShoto
118	Scott	Thourson
119	Seth	Currlin
120	Yash	Shah
121	Natalia	Fabela
122	Bethsymarie	Soto-Morales
123	Paxton	Guerin
124	Brooke	Barnes
125	Abby	Nason
126	Kaitlynn	Olczak
127	Diego	Castro
128	Alexis	Rivera
129	Eman	Shreteh
130	Kelly	Anderson
131	Heather	Blackwell
132	Mediha	Gurel
133	Zachary	Greenberg
134	Brittany	Partain
135	Yanxu	Chen
136	Wendy	Chai
137	Camryn	Lewis

138	Matthew	Becker
139	Raquel	Brown
140	Nagarajan	Rajagopal
141	Sruthi	Selvakumar
142	Alison	Shutterly
143	Elena	Yarmola
144	Yuhang	Wu
145	Ceran	Messam
146	Lucy	Tecle
147	Minhal	Yusufali
148	Joseph	Ficarrotta
149	Steven	Swingle
150	James	Graham
151	David	Rojas
152	Juanpablo	Olguin
153	Raffae	Ahmad
154	Victor	Lopez
155	Tori	Ellison
156	Bryan	Ibarra
157	Jahnelle	Jordan
158	Susan	Mathison
159	Bradley	Pliskow
160	Edward	Datz
161	Nicolas	Montoya
162	Ian	Malone
163	Dylan	Litherland
164	Hunter	Hakimian
165	Jamie	Paulus
166	Robby	Mijares
167	Natalia	Vallenilla
168	Raul	Cruz-Quintero
169	Tiffany	Conklin

170	Matthew	Melton
171	madhuvanthi	soundirarajan
172	Carlos	Rinaldi
173	Shaheen	Farhadi
174	Jesus	Penaloza
175	Nicholas	DiNapoli
176	sahil	deschenes
177	Kendall	Parker
178	Ashwin	Velraj
179	Dan	LaShoto
180	Shinichi	Sakurada
181	Appajosula	Rao
182	Afra	Toma
183	Jenna	Fulton
184	Winston	Chu
185	Greg	Hudalla
186	Ed	Phelps
187	Lee	Murphy
188	Anthony	Brennan
189	Greg	Sawyer
190	Cherie	Stabler
191	Whitney	Stoppel
192	Kevin	Otto
193	Dylan	Antsine
194	Christine	Schmidt
195	Paul	Print
196	Laurie	Gower
197	Chris	Batich
198	Ashutosh	Agarwal
199	Chelsea	Magin
200	Abby	Ziegler
201	Gulden	Camci-Unal

202	Shannon	Servoss
203	David	Norton
204	Zachary	Greenberg
205	Valentina	Garcia
206	Nicolas	Lopez
207	Yuhang	Wu
208	Yanxu	Chen
209	Haoqing	Yang
210	Georg	Scheutz

List of All Abstracts:

1. Title: "Elvax 40W-Based GABA Delivery for Beta Cell Regeneration in Type-1 Diabetes" Authors: K. Ling, M. Bhatta, M. Becker, R. Dolan, J. Stewart, N. Barnes, B. Keselowsky, E. A. Phelps

Abstract: Introduction: Type 1 diabetes (T1D) is an autoimmune disease characterized by autoreactive T cells that target and destroy insulin-producing beta cells in pancreatic islets [1]. Gamma-aminobutyric acid (GABA) has been demonstrated to regenerate lost beta cell mass, synchronize insulin secretion, and regulate autoimmune responses[1]. Islet regeneration therapies for T1D require daily intraperitoneal bolus injections of soluble GABA. The goal of this project is to engineer a polymeric resin drug release technique using specialized biomaterials in order to extend the period of controlled GABA administration. We hypothesized that using Elvax 40W ethylene vinyl acetate copolymer (E40W) as an implantable biomaterial for sustained GABA release would result in an improved method of T1D treatment due to an extended and optimal GABA release profile [1-3].

Materials and Methods: Elvax 40W GABA films were created using a single emulsion-evaporation strategy [2]. Aqueous GABA was loaded into Elvax 40W that was dissolved in methylene chloride. The mixture was then purified through solvent evaporation. The homogenized E40W and GABA mixture formed a polymeric resin film with distinct crystallinity. The GABA release profiles of the Elvax 40W films were characterized by suspending E40W films in ultra-pure water and freezing extracted aliquots at timed intervals. The concentration of GABA in each aliquot was measured by derivatization with o-Phthaldialdehyde, which renders amino acids fluorescent in a plate reader.

Results and Discussion: E40W films exhibited a pattern of GABA release that was consistent with a zero order linear release kinetics over at least a 10 day time period. Further analysis of E40W films with differing ratios indicated that a 3:5 (mg/mg) GABA to E40W ratio produced an optimal linear release profile that closely resembled GABA administration rates commonly cited in literature [3].

Conclusions: Elvax 40W GABA-release films are able to exhibit zero-order linear release profiles for at least 10 days of time. Adjustment of GABA to Elvax 40W ratios yields differing GABA release profiles and may be further optimized. Future work will include the determination of the effects on pancreatic islet health in-vivo.

2. Title: Exosome single cell sequencing using 3D printing
Authors: Senthilkumar Duraivel, Thomas E Angelini
Abstract: In many ways, high-throughput sequencing of individual EVs within large and heterogeneous cell populations is similar to its counterpart in single cell genome or single DNA molecule sequencing, including many of the technical challenges of microfluidic technologies. The single cell genome sequencing for characterizing large heterogeneous populations of cells shows difficulty of encapsulating single cells within single drops which in turn could be used as PCR reaction vessels. This project proposes to use the novel method of 3D printing for creating shapes from fluid phases and trapping them stably in 3D space. This method utilizes jammed microgel particles, swollen in either aqueous or organic solvents; a syringe needle is inserted into a jammed microgel bath and translated while injecting a liquid “ink” made from any desired constituents. This approach has been effective in creating stable structures made from aqueous polymers, colloidal particles, silicone elastomers, and liquid oil. In the work proposed here, we will inject a buffer containing dispersed EVs into an organic microgel material made from a polystyrene-block-ethylene/propylene (SEP) diblock copolymer and a polystyrene-block-ethylene/butylene-block-polystyrene (SEBS) triblock copolymer, swollen in light mineral oil. Surface tension between the aqueous buffer and the oily microgels will drive droplet formation instead of continuous 3D structures. With this approach, we can rapidly produce small droplets of well-defined size and distribution in space which are trapped in between the microgels. These EVs could be subjected to PCR thermocycling and then sequenced. By carefully choosing the concentration of the EVs in the buffer solution, we can produce droplets capable of single-EV sequencing.

3. Title: Advanced Manufacturing for Biomedical Applications
Authors: Marc Sole Gras, Kaidong Song, Yong Huang
Abstract: Organ printing is the layer-by-layer bottom-up fabrication of complex cellular organization of native tissues or organs by bioprinting multiple cell types and other biomaterials at designated positions. The rising success rate of transplants has resulted in a critical need for more tissues and organs. Approximately 95,000 people are on the waiting list for new organs in the U.S. alone, and some die every day waiting for transplants. Integrated with a better understanding of multicellular self-assembly, bioprinting-based organ printing provides a promising solution to the problem of organ donor shortage. While some major challenges in bioprinting are biological such as endothelialization, vascularization, and accelerated tissue maturation, it is of great importance to create scale-up technologies for the robotic fabrication of hollow three-dimensional (3D) vascular constructs for use as the first step toward organ printing and other related biomedical applications. Accordingly, various advanced manufacturing technologies including inkjet-, laser-, and extrusion-based printing technologies have been explored as enabling fabrication technologies for organ printing as well as other biomedical applications. For demonstration, complex constructs such as 3D vascular and vascular-like constructs and organ-on-a-chip devices have been successfully fabricated.

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

Abstract:
BACKGROUND: Brain tumors are particularly difficult to treat due to their relative isolation behind the blood brain barrier. Cytotoxic T cells elicited by cancer vaccines are capable of penetrating this barrier, but are limited by innate immune cells in tumor microenvironments that inhibit T cell function. There is therefore an unmet need for a method to reprogram the immune cells in the tumor microenvironment to promote antitumor T cell responses.
OBJECTIVE: We previously reported that systemically administered liposomes bearing RNA encoding tumor antigens profoundly activate innate immune cells in reticuloendothelial system (RES) organs. Here, we report a modified liposome formulation capable of redirecting this immunomodulatory nucleic acid cargo to immune cells in brain tumors.
APPROACH: Cationic liposomes with varying compositions were loaded with Cy3-labelled RNA or siRNA and injected intravenously into glioma-bearing mice. RNA uptake was assessed with flow cytometry and immunofluorescence microscopy after 18 hours.
RESULTS: Inclusion of cholesterol within liposomes increased mRNA uptake in intracranial GL261 and KR158b tumors after systemic injection in a dose-dependent manner. Optimized tumor-homing liposomes delivered mRNA encoding tumor antigens to CD45+ immune cells in both tumors. These liposomes were also used to deliver siRNA against programmed death ligand 1 (PDL1). siRNA-loaded liposomes reduced PDL1 expression on dendritic cells ex vivo and on transfected CD45+ cells in murine brain tumors.
CONCLUSIONS: Our optimized liposomes effectively deliver mRNA and siRNA to immune cells in multiple murine brain tumors. Future work will consider the mechanism of this enhanced delivery and the use of tumor-homing liposomes to deliver other immunomodulatory biomolecules.

5. Title: Bifunctional RNA nanoparticles induce antitumor immune responses and allow MRI-based detection of dendritic cell migration as a biomarker of antitumor immune response
Authors: Adam J. Grippin, Brandon Wummer, Elias J. Sayour, Adam Monsalve, Kyle Dyson, Tyler Wildes, Jon Dobson and Duane A. Mitchell
Abstract: A novel engineering silicon carbide (SiC) coating was applied on dental fluorapatite glass-ceramic veneer. The aim of this study was to enhance the chemical durability and abrasion resistance of veneering ceramic materials by applying a bilayer SiO2-SiC coating on the surface. Samples were immersed in pH 10 and pH 2 buffer solutions for 15 days and 30days at 80 oC. The chemical durability of SiC and glass-ceramic veneer materials was studied by examining weight loss and ion release levels obtained from inductively coupled plasma atomic emission spectrometer (ICP). The surface morphology was analyzed through scanning electron microscopy (SEM). Abrasion resistance of the coated and non-coated disks was tested using a chewing simulator with 49N load for 15000 cycles. The SiC coated group showed significant corrosion resistance compared with the non-coated group as demonstrated by a decrease in weight loss across all the test solutions and time ($p < 0.0001$). Ion release demonstrated either a marginally lower or significantly lower release for the SiC coated group. The morphology of non-coated group showed severe surface degradation, while the SiC coated group confirmed a protective effect. The abrasion test demonstrated a 25 to 30% reduction in vertical loss (μm) and volume loss (mm3) for the SiC group compared with the non-coated group. In conclusion, a novel

SiC coating demonstrated enhanced chemical durability and improved wear resistance for ceramic veneers.

6. Title: Novel coating to enhance physical properties of a glass-ceramic veneer
Authors: Hsu SM, Ren F, Chen Z, Kim MJ, Beers K, Clark AE, Neal D, Fares C, Esquivel-Upshaw JF
Abstract: A novel engineering silicon carbide (SiC) coating was applied on dental fluorapatite glass-ceramic veneer. The aim of this study was to enhance the chemical durability and abrasion resistance of veneering ceramic materials by applying a bilayer SiO2-SiC coating on the surface. Samples were immersed in pH 10 and pH 2 buffer solutions for 15 days and 30days at 80 oC. The chemical durability of SiC and glass-ceramic veneer materials was studied by examining weight loss and ion release levels obtained from inductively coupled plasma atomic emission spectrometer (ICP). The surface morphology was analyzed through scanning electron microscopy (SEM). Abrasion resistance of the coated and non-coated disks was tested using a chewing simulator with 49N load for 15000 cycles. The SiC coated group showed significant corrosion resistance compared with the non-coated group as demonstrated by a decrease in weight loss across all the test solutions and time ($p < 0.0001$). Ion release demonstrated either a marginally lower or significantly lower release for the SiC coated group. The morphology of non-coated group showed severe surface degradation, while the SiC coated group confirmed a protective effect. The abrasion test demonstrated a 25 to 30% reduction in vertical loss (μm) and volume loss (mm3) for the SiC group compared with the non-coated group. In conclusion, a novel SiC coating demonstrated enhanced chemical durability and improved wear resistance for ceramic veneers.

7. Title: Attenuating Multiple Sclerosis in Mice with an Antigen-Specific Vaccine
Authors: Alexander Kwiatkowski, Joshua Stewart, Jonathan Cho, Theodore Drashansky, Eric Helm, Ashley Zuniga, Dorina Avram, and Benjamin Keselowsky
Abstract: Multiple sclerosis (MS) is a disease that affects over 2.4 million people worldwide, with over 10,000 new cases each year. The disease has physical symptoms manifest as white matter lesions in the central nervous system (CNS) caused by infiltrating immune cells demyelinating axons. Briefly, our treatment system utilizes an antigen specific approach using four microparticles (MP) encapsulating the autoantigen myelin oligodendrocyte glycoprotein (MOG35-55) along with a dendritic cell recruitment factor, granulocyte-macrophage colony-stimulating factor (GM-CSF), and two tolerogenic factors transforming growth factor beta-1 (TGF-β1), and vitamin D3 (VD3), respectively. Microparticle formulation: MPs were fabricated for VD3, TGF-β, GM-CSF and EAE-specific antigen (MOG35-55) or an irrelevant antigen (Ovalbumin; OVA323-339) using encapsulation in 50:50 PLGA. The VD3 and antigen-loaded microparticles were fabricated to be 1 μm in diameter to allow for phagocytosis, while TGF-β1 and GM-CSF microparticles were fabricated to be 30 μm in diameter to avoid phagocytosis and release the chemotactic/tolerogenic factors extracellularly.In vivo experiments: All animal experiments were approved by the University of Florida IACUC. EAE was induced in C57/BL6 mice and mice were subsequently scored. MPs were injected subcutaneously with MPs and a booster injection of the same particle formulation three days later. EAE scores were significantly lower in MOG35-55 treated mice compared to those treated with OVA323-339 when studies were done treating at the

peak of disease. Preliminarily, flow cytometry showed that there was a tolerogenic cell phenotype in the dual MP (dMP) MOG35-55 treated mice and a pathogenic phenotype in the dMP OVA323-339 treated mice. This was shown by a lower number of immune cells infiltrating the central nervous system of dMP MOG35-55 treated mice. The CNS-infiltrating CD4+ T-cells in MOG35-55 mice were less pathogenic than dMP OVA323-339 treated mice. This was marked by lower expression of transcription factors T-bet and RORγt, suggesting lower Th1 and Th17 response. In addition, there were less CD8+ cytotoxic T-cells in the MOG35-55 mice compared to the OVA323-339 mice. Finally, luxol fast blue staining of the lumbar region of the spinal cord showed that there was less demyelination in dMP MOG35-55 treated mice compared to mice treated with dMP OVA323-339.

8. Title: Localized Release of Steroids from Macroporous Organosilicone Beads Scaffolds
Authors: Jia-Pu Liang, Robert Accolla, Kaiyuan Jiang, Cherie Stabler
Abstract: Transplant-associated inflammatory responses lead to decreased efficacy for cell-based treatment platforms. Localized delivery of anti-inflammatory agents at the site of transplant presents a promising solution to this problem without the need for potentially detrimental systemic delivery. To accomplish this goal, our lab employed a highly porous polydimethylsiloxane (PDMS)-based scaffold platform to deliver anti-inflammatory agents, such as dexamethasone (Dex), to improve the outcomes of islet transplantation for the treatment of type 1 diabetes [1]. To achieve more controlled and extended drug release, an improved “bead” scaffold platform was developed, where encapsulated PDMS beads were embedded within PDMS-based scaffolds. This double-encapsulation approach should provide more controlled and durable drug release. While the Dex “bead” scaffold presented the potential to reduce inflammatory cell infiltration for longer periods then previous scaffolds, it also delayed vascularization of the scaffold required for supporting cells within the graft. To mitigate this effect, our lab generated a multi-drug delivery system by including pro-angiogenic agent estradiol (E2) beads (75 ± 51 μm in diameter). The resulting “bead” scaffold retained an 85% porosity. In vitro release studies showed scaffolds incorporating both 0.10% (wt%) Dex and 0.01% (wt%) E2 had total release of 1.5 to 13.7 ng/mL and 0.05 to 8.1 ng/mL respectively. Histological staining of explanted scaffolds suggests that pro-angiogenic E2 has the potential to promote vascularization of scaffolds, in conjunction with the anti-inflammatory effects of Dex. With these results, future work will further explore the positive effects of E2 by characterizing functional vasculature within the graft via lectin perfusions and analyzing macrophage polarization towards a pro-healing M2 phenotype via FACs analysis of the infiltrating cell populations.
References: [1] Jiang, Kaiyuan, et al. “Local release of dexamethasone from macroporous scaffolds accelerates islet transplant engraftment by promotion of anti-inflammatory M2 macrophages”. Biomaterials 114 (2017) 71-81

9. Title: Characterization of Injectable Chemically-Decellularized Peripheral Nerve Scaffolds
Authors: Vaughn NE, McCrary MW, Song YH, Morley C, Angelini TE, and Schmidt CE
Abstract: Spinal cord injury (SCI) is a devastating condition that leads to partial to complete paralysis. Currently, no available therapy fully restores lost function. One promising preclinical therapy for SCI is injectable decellularized peripheral nerve (iPN) scaffolds. However, the current standard decellularization method to generate iPN is not feasible due to discontinuation of key

detergents. Our lab recently developed a novel decellularization method based on sodium deoxycholate and deoxyribonuclease (SDD method) that matches the previous standard method. The aim of this study was to generate iPN scaffolds from SDD decellularized nerves and characterize the properties of resulting hydrogels. To accomplish this, rat sciatic nerves were aseptically harvested, decellularized, lyophilized, minced, and then incubated in pepsin-acid solution. After 72 hours, the solution was neutralized to physiological pH (~7.4) and then incubated at 37℃ to generate iPN hydrogels. Hydrogel formation was characterized via handling, turbidity gelation kinetics measurement, confocal reflectance microscopy, particle tracking microrheology, microindentation, swelling ratio, in vitro degradation, and in vitro release of a mock protein. Commercially available collagen-I gels served as controls. Overall, nerves decellularized using the SDD method were amenable to enzyme/acid solubilization to generate iPN scaffolds. Tissue concentrations of 7.5 and 10 mg/mL formed robust hydrogels in less than 20 minutes that withstood handling. Additionally, turbidity gelation kinetics and confocal reflectance imaging showed collagen fibrillogenesis-mediated gelation of iPN scaffolds. Preliminary mechanical characterizations showed that iPN hydrogels have storage moduli between 25 and 40 Pa, and compressive moduli between 140 and 191 Pa. Although significantly softer than collagen controls ($p<0.05$), iPN hydrogels were on the same magnitude as rat neural tissue (~100 Pa). iPN hydrogels had significantly higher swelling ratios compared to collagen ($p<0.05$). 7.5 mg/ml iPN gels were completely degraded by 15 days while 10 mg/ml iPN lasted 30 days. We observed similar release profiles between all iPN and collagen groups where approximately 90% of the encapsulated mock protein was released by 10 hours and completely released by 48 hours. Moving forward, we plan to further characterize the mechanical properties and biocompatibility of the scaffolds both in vitro and in vivo.

10. Title: Responses of spinal neural progenitor cells to chronic microstimulation
Authors: Malone IG, Dale EA, Joulaee Y, Nash MA, Natalie AS, Santana JP, Starr EE, Otto KJ, Reier PJ
Abstract: Advances in electrical stimulation of the spinal cord to improve function have led to the concept of engineering neuroplasticity, which may be extended to the application of stem cell therapies. We have begun to explore this possibility by combining intraspinal microstimulation (ISMS) with grafts of neural progenitor cells (NPCs). Our initial studies are designed to determine whether: (a) ISMS adversely affects viability of NPCs and (b) indications are exhibited of an influence on axonal growth. Hemisection lesions were made at the cervical level, and either whole pieces or suspensions of 14-day rat embryonic spinal cord tissue were immediately introduced. Following closure of the dura, a microwire electrode was inserted into the lesion/graft cavity, thus allowing direct exposure of grafted donor cells to the source of stimulation using open- or closed-loop approaches. The data presented here include results from: graft + closed-loop ISMS (n=2), graft + open-loop ISMS (n=1), ISMS only (n=1), and graft only (n=1). ISMS was delivered via a 30 µm platinum-iridium microwire delivering 40 µA of current at 100 Hz. Stimulation was applied for 5 hours/day, 5 days/week. After one month of stimulation, animals were perfused, and specimens were obtained for cryosection and subsequent general histological analysis. Our preliminary data show that grafted fetal tissue survived and matured even in the presence of a penetrating electrode delivering current. Serotonin-GFAP immunostaining also provided an indication of a growth effect both in terms of ingrowth into grafts, as well as unexpected growth in

lesion fibroglial scar tissue. These early data thus demonstrate fundamental feasibility of combining electrical neuromodulation with a spinal cord repair strategy, both of which have individual FDA approval. Future studies will focus on testing this combinatorial strategy's potential to improve respiratory function after high-cervical spinal cord injury. Supported by the Craig H. Neilsen Foundation, the Bryon Riesch Paralysis Foundation, and the Fraternal Order of Eagles.

11. Title: Effect of Ethylene Oxide Sterilization on the Electrical Characteristics of Shape-Memory Polymer Nerve Cuff Electrodes

Authors: Brandon S. Badamtchian, Kaitlynn P. Olczak, Kevin J. Otto

Abstract: Ethylene oxide (EtO) sterilization is a regularly utilized practice when sterilizing electronic components used in biomedical applications, and is best used for conditions where temperature and moisture must be kept low to avoid affecting the properties and overall performance of the biomedical device in question. EtO sterilization has been shown to be effective at eliminating microorganisms and spores from electronic components, and at present, it has not been shown to cause damage or otherwise negatively affect the electrical properties of devices used in biomedical applications. Previous work has evaluated the effect of sterilization on Shape Memory Polymer (SMP) mechanical properties. However, the impact on the electrical properties previously remained unknown. In this experiment, the electrical characteristics of SMP nerve cuff electrodes were measured using Electrochemical Impedance Spectroscopy (EIS), both before and after sterilization with EtO, in order to observe any difference in the electrochemical behavior of the electrodes. Three cuff electrodes, each with four titanium nitride electrode sites, were tested using EIS before and after EtO sterilization; their electrical impedances across different frequencies, electric potential as a function of time, and current versus potential were observed before and after sterilization. It was found that the impedance at 1kHz frequency was not significantly affected by the EtO sterilization ($p > 0.05$). From the Nyquist plots, one can infer that EtO sterilization does not affect the electrode impedance over a broad range of frequencies (10 Hz to 100 kHz). These results show that EtO sterilization is a safe procedure to use when sterilizing SMP electrodes and support previous findings regarding the effect of EtO sterilization on electronic components used in biomedical applications.

12. Title: A Chimeric, Multivalent Fusolectin of Galectin-1 and Galectin-3 with Enhanced Extracellular Activity

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

Abstract: Galectins are a diverse family of proteins capable of inducing cell death, modulating cell signaling, and directing cell trafficking by binding extracellular glycans. Galectin-1 (G1) can selectively deplete certain T cell subsets, which has led to increasing interest in G1 as an immunomodulator. However, high M concentrations are required for G1 to be in the active homodimeric state, which challenges its therapeutic efficacy. Prior work has demonstrated that the bioactivity of G1 can be increased by stabilizing its dimeric conformation, for example via PEGylation [1], yet even these stable variants have effective doses in the mM range due to the weak glycan-binding affinity of G1. To further decrease the effective dose of G1, we increase its glycan-binding affinity via fusion to galectin-3 (G3). We recently demonstrated that fusing enzymes to galectin-3 (G3) can extend their residence time in various tissues by endowing affinity for extracellular glycans, yet the signaling activity of G3 is knocked out when another protein is

fused to its N-terminus [2]. Assembling G3 fusions into a trimeric supramolecular architecture further increased glycan-binding affinity via multivalent avidity effects [2]. Based on these observations, we developed and characterized the immunomodulatory activity of a G1/G3 fusion, as well as a dimeric assembly created by inserting a coiled-coil forming peptide between the G1 and G3 domains. We report a G1/G3 fusion supramolecular assembly with enhanced immunomodulatory activity. A tetravalent galectin fusion had increased carbohydrate-binding affinity compared to G1, and more potently suppressed Jurkat T cell metabolism than an established stable G1 dimer. We envision this self-assembling fusion will be a more potent T cell immunomodulatory therapeutic than previously reported G1 dimers.
References:[1] Fettis & Hudalla. Bioconjugate Chemistry, vol. 29, no. 7, 2018, pp. 2489–2496. [2] Farhadi, et al. Nature Communications. 9, 2018.

13. Title: Engineering tunable growth factor and cytokine release rates from silk-extracellular matrix scaffolds to reduce scar formation and chronic inflammation following muscle injury
Authors: JF Jameson, JM Grasman, EC Bender, KM Clark, AM Espinoza, LD Black, III, DL Kaplan, and WL Stoppel
Abstract: The long-term goal of our work is to develop natural biomaterials that, upon implantation, modulate tissue level in vivo behavior and collective cell function for soft tissue repair and rehabilitation. One strategy we are employing focuses on modulation of tunable material properties to alter growth factor delivery rates in conjunction with biomaterial degradation in vivo. In this study, composite silk sponges were formed via the addition of collagen, heparin, and/or a growth factor at varying concentrations and the resulting materials properties and growth factor activity levels are under investigation. Initial results demonstrate that varying the composition of the composite sponge-like scaffold as well as the formulation method for addition the bioactive components qualitatively alters the types and rate of cell infiltration, the rate of scaffold degradation, and the eventual deposition of proteins in the implant area. For example, using unseeded silk scaffolds with solubilized or insolubilized key factors (Vascular Endothelial Growth Factor, Heparin) implanted in Sprague Dawley rats positively impacted vascularization, adipose tissue, and cell migration into the scaffold. Current work aims to expand upon these qualitative results to use image analysis methods to quantify the percent cell infiltration, the overall scaffold area, and the types of cells present within the scaffold after 1, 2, 4, and 8 weeks post implantation. Results from in vivo implantation will be correlated with in vitro assays to measure growth factor release rates and effective diffusivities to guide scaffold design and optimization and enable predictive scale-up of the system for future studies in a model rat system investigating skeletal muscle rehabilitation following volumetric muscle loss.

14. Title: Electrochemical features and long-term stability of electrode-site geometry of intracortical neuroprostheses
Authors: Veit N.C.; Urdaneta M.E.; Pattanshetti A. ; Peñaloza J.D. ; Otto K.J.
Abstract: The potential of intracortical devices to treat neurological diseases such as paralysis via brain machine interfaces has propelled the design of novel implantable devices. For example, reducing the volume of the device to subcellular sizes have been found to considerably mitigate the foreign body response and the associated decay in chronic stability. An alternative approach to reducing the volume of the device could be decreasing the size of the electrode-sites.

Nevertheless, the role of electrode-site size in the long-term stability of intracortical devices remains uncertain. Herein, we evaluated the ability of different electrode sites to longitudinally record and stimulate through Impedance Spectroscopy (EIS) and Voltage Transient (VT). The two techniques provide information about the frequency dependent components of the electrode as well as the electron transfer rate of reaction in the electrode-electrolyte interface. Namely, EIS and VT evaluate the electrodes' efficiency in terms of resistance to current flow when recording and stimulating, respectively. To achieve this goal, a custom-made silicon device was implanted into the somatosensory cortex of rats. Each device has four shanks, identical in length, with four randomly distributed electrode sites of areas 800, 2400, 7200, and 21600 um2. Preliminary analysis shows, for both EIS and VT, an initial increase in magnitude during the first week post-implantation and stabilizing thereafter for all electrode sizes. As hypothesized, we identified a gradual increase on the resistance's magnitude as electrode's size decreases, suggesting an inverse relationship between electrode-site size and resistance. Overall, this proportional change overtime suggests a homogenous chronic response across electrode-sites, regardless of area. These insights could potentially benefit the design and development of more chronically stable neuroprosthetic devices.

15. Title: Chemotactic tumor targeting in spatially patterned structures
Authors: Cameron Morley, Ginger Moore, Catherine Flores, Duane Mitchell, Tommy Angelini
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 chemotactic 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 cytokines to leave the tumor and trigger T cell targeting. This spatiotemporal relationship allows the determination of the cytokine diffusion coefficient.

16. Title: Iron oxide-loaded liposomes for effective RNA delivery and dendritic cell tracking
Authors: Mackenzie Grubb, Adam J. Grippin, Elias J. Sayour, Brandon Wummer, Adam Monsalve, Kyle Dyson, Tyler Wildes, Jon Dobson and Duane A. Mitchell
Abstract: Effective biomarkers are a vital tool in the clinical application of cancer therapies, and particularly immunotherapies to assist oncologists in making informed treatment decisions and reduce patient toxicity.(Amin et al, BMC Cancer 2016). We previously showed that RNA-pulsed dendritic cells (DCs) prolong progression free and overall survival in patients with glioblastoma, and these clinical outcomes may be predicted by tracking DC migration to the lymph nodes (Mitchel et al, Nature 2015). In this work we have developed iron oxide-loaded liposomes for the binding and delivery of RNA to DCs ex vivo to increase transfection efficiencies and allow tracking of DC migration in vivo via magnetic resonance imaging. Immune stimulatory cationic liposomes were loaded with iron oxide of varying amounts (i.e. 1-150 μg) and characterized for size and zeta potential. Magnetic liposomes were then incubated with RNA to demonstrate effective binding

and showed a significant increase in binding capacity with the inclusion of iron oxide. RNA-loaded magnetic liposomes successfully transfected DC2.4s and increased transfection efficiencies for increasing amounts of iron oxide present in the liposomes in the absence of a magnetic field. Furthermore, cells treated with iron oxide loaded-RNA nanoparticles (IO-RNA-NPs) in the presence of a magnetic field pulling the particles into contact with DCs showed double the GFP expression in 30 minutes of incubation compared to cells incubated overnight in the absence of a magnetic field. We then evaluated IO-RNA-NPs for use as a biomarker. We showed a significant linear correlation between lymph node size and pixel intensity to the number of injected cells in the lymph node. IO-RNA-NPs may therefore serve as a suitable biomarker for DC migration to the lymph node.

17. Title: Electrical Stimulation of Adipose-derived Stem/Stromal Cells and Subsequent Secretome Characterization
Authors: Aria R. Henderson, Deanna Bousalis, Nicole A. Bohmann, Nora Hlavac, Erin Patrick, Sahba Mobini, Christine E. Schmidt
Abstract: Spinal cord injury (SCI) is debilitating and costly, with limited therapeutic options. Local electrical stimulation (ES) of the damaged spinal cord has been used clinically to promote neural regeneration; however, such procedures are invasive. Researchers have shown that the secreted factors (“secretome”) of adipose-derived stem/stromal cells (ASCs) rescue and repair nerve tissue after damage and are pro-survival and tropic. Hence, utilizing the secretome of stimulated cells could be a way to deliver the benefits of ES indirectly to SCI sites. In this project, we tested the hypothesis that specific ES regimes cause human ASCs (hASCs) to secrete pro-regenerative factors. hASCs were seeded in an electro-bioreactor and electrically stimulated with either 1 Hz, 20 Hz, or 1000 Hz pulses, with an intensity of 20 mV/mm, for 1 hour/day for 3 days. On day 4, the conditioned media was collected. Cell metabolic activity and viability were quantified via alamarBlue and Live/Dead assays, respectively. Results showed more live hASCs are detectable in the electrically-stimulated groups than the non-stimulated control after 3 days, though the metabolic activity did not change. Human umbilical vein endothelial cells (HUVECs) were seeded on Matrigel and treated with secretome from electrically stimulated hASCs to assess endothelial tube formation. Blinded semi-quantitative image analysis was performed using ImageJ. This includes analyzing the network density and structure of the endothelial tubes through measuring the areas of enclosed tubule formations (“meshes”) and percentage of complete tubules as compared to fragmented/incomplete tubules. In preliminary trials, the secretome from hASCs exposed to 20 mV/mm and 1000 Hz electrical pulses revealed improvement in tube formation in HUVECs, demonstrating the pro-regenerative effect of secretome from stimulated hASCs. With the promising results from 1000Hz ES, we will investigate other high-frequency regimes and additional seeding densities in the near future with more distant plans to characterize the protein profile of this secretome, combine it with an injectable hydrogel system, and test its therapeutic efficacy in an SCI in vivo model.

18. Title: Iron oxide loaded liposomes enable early prediction of antitumor response with MRI
Authors: 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

Abstract: Cancer immunotherapy has led to breakthroughs in cases where traditional treatments have produced minimal results. Although immunotherapeutic strategies have shown promising improvements to overall survival, these therapies are often associated with significant toxicity and only a portion of patients respond to treatment. There is therefore an unmet need for biomarkers to distinguish patients that will and will not benefit from immunotherapeutic treatment for cancer. Our lab recently showed that dendritic cell (DC) migration to lymph nodes may be one such biomarker of response to DC vaccines in patients with glioblastoma. Unfortunately, the imaging techniques most often used to track DC migration (PET and SPECT) are not widely available. Thus, we have developed RNA-loaded magnetic nanoparticles to enhance DC migration and track migration in-vivo using MRI, which is much more widely available. Iron Oxide nanoparticles were complexed with mRNA and the resulting nanoparticles were used to transfect DCs ex-vivo in the presence of a magnetic field. IO-RNA-NP-loaded DCs were then injected intra-dermally into tumor-bearing C57Bl6 mice and tracked non-invasively with T2-weighted 11T MRI. Our results indicate that these nanoparticles improve the migration of DCs to lymph nodes, and enabled distinction of responding and non-responding patients via an MRI-based imaging technique just two days after vaccination. We found that T2-weighted MRI intensity in lymph nodes correlated with the number of IO-RNA-NP-loaded DCs in those lymph nodes and consequently predicted inhibition of tumor growth and survival in murine tumor models. Therefore, RNA-loaded nanoparticles enhance DC migration and provide an efficient MRI-based modality to track DC migration to lymph nodes as a biomarker for anti-tumor vaccine response.

19. Title: Nanoparticle-mediated knockdown of TGFBR2 improves Natural killer cell cytotoxicity
Authors: Isaac Adjei, Jahnelle Jordan, Nhan Tu, Thu Le Trinh, Sheng Wei, Blanka Sharma
Abstract: Statement of Purpose: Natural Killer (NK) cells therapies have demonstrated success in the treatment of certain hematological malignancies but face challenges with solid tumors. Tumors produce immunosuppressive factors like transforming growth factor beta (TGF-β)-1 that inhibits the function of NK cells. We hypothesize that knockdown of TGF-β receptor 2 (TGFBR2) in NK cells would make them resistant to TGF-β1 inactivation and restore cancer cell killing functions. In this study, we examined the nanoparticle (NP) mediated siRNA delivery for gene knockdown to improve NK cell function. Methods: Manganese dioxide NPs for siRNA delivery were synthesized by the reduction of potassium permanganate with polyallylamine hydrochloride and stabilized with polyethylene glycol (pMnO2-NP). The NPs were characterized for size and zeta potential. Uptake of pMnO2-NPs by NK cells was evaluated by fluorescent microscopy and cell viability assessed by flow cytometry. Mobility shift assay was used to assess pMnO2-NP complexation to and protection of siRNA from RNase degradation. Knockdown of TFGBR2 in NK cells was evaluated by real-time qRT-PCR and immunofluorescent staining. The cytotoxic ability of NK cells to lung cancer cells was assessed by LDH assay. Interferon-gamma (IFN-γ) production by NK cells was evaluated by ELISA.
Results: The pMnO2-NP had hydrodynamic number weighted size of 15 nm, TEM size of 8 nm and zeta potential of +35 mV. Mobility shift assay showed that pMnO2-NPs complexed siRNA and protected them from RNase I degradation. The pMnO2-NPs were endocytosed by NK cells without cytotoxicity. The delivery of siRNA to TGFBR2 by pMnO2-NP to NK cells resulted in 90% knockdown of the TGFBR2 receptor in NK cells and improved their infiltration and killing of cancer

spheroids. Significantly, the suppression of TGF-β signaling via TGFBR2 receptor knockdown restored NK cell killing of lung cancer cells even in the presence of TGF-β1. Treatment of NK cells with pMnO2-NP-siRNA also increased IFN-γ production in response to the malignant cells.
Conclusions: Results from this study show the feasibility of increasing the resilience of NK cells to the immunosuppressive environments in tumors and lay the groundwork for future studies that evaluate the in vivo efficacy of this nanoparticle system.

20. Title: Harnessing Strained Disulfides for Photocurable Dynamic Hydrogels
Authors: Georg M. Scheutz, Jonathan L. Rowell, Sarah T. Ellison, Thomas E. Angelini, and Brent S. Sumerlin
Abstract: Reversibly associating crosslinks in polymer materials promote viscoelasticity, self-healing behavior, and stimuli-responsiveness. Adaptable hydrogels, dynamically-crosslinked networks swollen in large amounts of water, have shown great promise in many applications such as drug delivery, cellular engineering, or self-healing materials. Herein, the self-assembly of amphiphilic dendritic polymers was employed to create transient hydrogel scaffolds with photosensitive cyclic disulfides embedded in the hydrophobic regions. Chemical crosslinking of the gel was achieved via photoinduced disulfide cleavage in less than ten minutes. Careful synthetic design of the cyclic disulfide crosslinker provided photocuring with low-energy light, and tunable mechanical properties depending on irradiation time. Furthermore, a small molecule dye was encapsulated into the gel showing prolonged, slow release without a trigger, or “burst” release upon a redox stimulus. Overall, the modular gelation strategy of assembly prior to crosslinking permits the formation of strong hydrogels at low crosslinker contents due to the local confinement of crosslink-able moieties in the hydrophobic cores of the network assemblies. We believe that this approach represents an attractive avenue to a diverse library of adaptable self-assembled hydrogels with tunable properties.

21. Title: Development of S-nitroso-N-acetylpenicillamine (SNAP) Impregnated Medical Grade Polyvinyl Chloride for Antimicrobial Medical Device Interfaces
Authors: Corbin Feit, Manjyot Kaur Chug, Dr. Elizabeth Brisbois
Abstract: In the clinical setting, polyvinyl chloride (PVC) accounts for 25% of all polymers used in medical device applications. However, medical devices fabricated with PVC, such as endotracheal tubes, extracorporeal circuits (ECCs), or intravenous catheters suffer from thrombosis and infection. Mortality associated with HAIs and thrombus complications exceed 100,000 deaths each year. One method to overcome these challenges is to develop bioactive polymers with nitric oxide (NO) release. Nitric oxide is an endogenous radical molecule with antibacterial, antithrombic, anti-inflammatory, among several other critical biological functions. In this study, Tygon® PVC tubing was impregnated with an NO donor molecule, S-nitroso-N-acetylpenicillamine (SNAP), via a simple solvent-swelling method, where polymer samples were submerged in a SNAP (40-80 mg/mL) containing solvent mixture (methanol, acetone, plasticizer). An additional topcoat of a biocompatible CarboSil 2080A (CB) was applied to reduce SNAP leaching. The SNAP impregnated polymers were characterized for NO release using chemiluminescence, leaching with UV-Vis spectroscopy, surface characterization with scanning electron microscopy, tensile strength analysis, stability during storage and sterilization, and antimicrobial properties in vitro. The 6.0 wt% SNAP-PVC-CB exhibited NO flux of 4.29 ± 0.80 x

10^-10 mol cm^-2 min^-1 over the initial 24 h under physiological conditions (incubated in PBS at 37°C) and continued to release physiological levels of NO for up 14 d. The total SNAP leaching was reduced by 86% with the addition of CarboSil topcoat during incubation. Mechanical properties and surface topography remained similar to control PVC after SNAP-impregnation and application of topcoat. After 1-month storage at -20°C, 23°C and 37°C, the SNAP-PVC-CB retained 95%, 93%, and 82% of initial SNAP content, respectively. The SNAP-PVC-CB also exhibited stability after ethylene oxide sterilization, retaining 93% SNAP. In a 24 h antibacterial assay, SNAP-PVC-CB reduce viable bacteria colonization of S. aureus and E. coli compared to PVC controls by > 90%. This novel method for SNAP impregnation of medical grade plasticized PVC holds great potential for improving the biocompatibility of post-fabricated PVC medical devices.

22. Title: Integration of antifouling and nitric oxide releasing-polymer for enhanced biocompatibility of insulin cannula
Authors: Manjyot Kaur Chug, Sean Hopkins, Jitendra Pant, Megan Douglass, Corbin Feit, Hitesh Handa, Elizabeth J Brisbois
Abstract: Insulin infusion pump therapy is an advanced technique for delivering insulin and maintaining blood glucose levels in Type1 diabetes patients. However, subcutaneous placement of the insulin infusion cannula triggers rapid protein adsorption and activation of neutrophils and macrophages causing localized inflammation. Additionally, lack of skin disinfection prior to cannula placement can lead to the growth of bacteria on cannula resulting in bacterial infection. Reports suggest that ~36% of insulin pump users have infection or inflammation at the infusion site and insulin infusion sets have a 65% failure rate after 7 days of implantation. These complications can lead to inadequate insulin delivery and infection, thereby requiring rotation of cannula site every 2-3 days. To overcome these challenges, we present a new generation of insulin infusion cannula that is developed with bioinspired polymers integrating antifouling slippery, liquid-infused porous surface (SLIPs) technology with active nitric oxide (NO) releasing polymer. Nitric oxide is an endogenous signaling molecule with potent anti-inflammatory and antibacterial properties. The cannulas were developed by impregnating the nitric oxide (NO) donor S-nitroso-acetylpenicillamine (SNAP) and silicone oil in commercial medical grade silicone rubber tubing, via a solvent swelling process. The NO release was characterized using chemiluminescence, leaching of SNAP was quantified using UV/Vis spectroscopy and the efficacy of the cannula for protein adsorption and antibacterial properties was evaluated using in vitro bioassays under physiological conditions. The NO-releasing cannulas release physiological levels of NO for > 7 days and exhibit > 90% reduction of pathogen (Staphylococcus aureus and epidermidis) compared to the uncoated controls. This NO-releasing polymer can enhance the biocompatibility of cannula ultimately improving the efficacy of insulin delivery with better care and quality of life.

23. Title: Characterization of IL-10 Surface Functionalization of Islet Analogs on Macrophage Polarization
Authors: Danielle Miller, Sydney Wiggins, Cherie Stabler
Abstract: Type 1 diabetes (T1D) is a disorder characterized by the autoimmune destruction the of insulin-producing beta cells function of the islets of Langerhans within the pancreas. Previous

work with cell-based therapies involved transplanting allogeneic islets into the hepatic portal vein to restore real-time patient glucose responsiveness. However, this method suffers heavy islet loss within the first week post transplantation due to the innate immune system response. The primary cells that orchestrate this innate inflammatory response are macrophages, which can exhibit a pro-inflammatory (M1) or anti-inflammatory (M2) phenotype depending on their stimuli. In this study, we explored the feasibility of functionalization of the islet surface with an anti-inflammatory cytokine (IL-10) as a method to reduce the macrophage pro-inflammatory response.

To functionalize the islets surface, we sought to employ a PEG-based linkage strategy. The approach was to first link PEG chains to the surface via NHS-PEG-maleimide, whereby the NHS is bind to free amines on surface of the islet. IL-10, functionalized with thiol (SH), could then be linked to this PEG via Michael's addition. To first validate the feasibility of the chemistry, dextran beads with a collagen shell were used as an islet analog. The surface of these idealized beads was first conjugated with polyethylene glycol (NHS-PEG-mal). Next, a fluorophore-functionalized thiol group (SH-FITC) was used as a fluorescent reporter to confirm conjugation. The density of the NHS-PEG-mal-SH-FITC coating was examined at varying incubations time to identify optimal experimental conditions. Image analysis established 45 minutes as a incubation time. In order to verify the specificity of the conjugation (NHS-PEG-mal-SH-FITC), results were compared to beads conjugated with methylated polyethylene glycol (NHS-mPEG) and with the thiolated fluorophore (SH-FITC) alone. Image analysis confirmed a 3-4 fold increase in FITC labeling, when compared to control groups. This ligation approach was then translated to SH-IL-10, whereby the resulting IL-10 bioactivity and the impact of BSA stabilization was evaluated. There was a significantly greater amount of IL-10 conjugated to the surface when BSA was used, than without BSA. Future work will explore the utility of IL-10-functionalized beads to dampen the activation of lipopolysaccharide-stimulated bone marrow-derived macrophages (M1).

24. Title: Effects of the Human Placental Matrix and Culture Conditions on Chondrogenesis in Mesenchymal Stem Cells

Authors: Dayita Wable, Olivia Lanier, Adam Monsalve, Sridevi Conjeevaram, Jon Dobson, Peter McFetridge

Abstract: The rising demand for tissue engineering in regenerative medicine has called for a greater understanding of ideal cartilage scaffolds and the role that growth factors play in promoting chondrogenesis. Cartilage tissue possesses inadequate potential for self-regeneration and therefore supplements are needed to enhance the body's ability to combat polychondritis, an autoimmune rheumatic disorder characterized by episodes of painful, destructive inflammation of the cartilage and other connective tissues in many organs. The McFetridge lab at University of Florida has developed the human placental matrix (hPM) which is composed of a complex mixture of cytokines, growth factors, chemokines, and extracellular matrix proteins It is hypothesized that hPM will better model the natural regenerative processes. Aim 1 of this study was to determine the potential of the hPM to influence the chondrogenic differentiation of human Wharton's jelly-derived mesenchymal stem cells (WJMSCs), in an in vitro monolayer. Aim 2 of this study was to investigate the potential of cartilage scaffolding in sustaining chondrogenic growth. To that end, WJMSCs were seeded onto decellularized porcine disk scaffolds to compare gained chondrogenesis in both two and three-dimensional cultures.

WJMSCs were isolated via explant culture from umbilical cords obtained from UF Health Shands Hospital. WJMSCs were differentiated into chondrocytes in two 24-well plates for a duration of 7, 14, and 21 days by exposure to supplemented DMEM .The WJMSCs were subject to treatments of 1%, 10%, 25% and 50% hPM dissolved in the media. Cells were then stained with Alcian blue to detect sulfated GAGs content, Safranin-O and Sirius Red to detect collagen growth, in respective wells. WJMSCs were seeded on top of submerged porcine discs and subjected to the same culture conditions as the monolayer culture.
Alcian blue staining showed increased GAG production in wells treated with a solution of chondrogenic media and 50% hPM as compared to controls. Both Safranin-O and Sirius Red staining demonstrated more collagen production in wells treated with the highest hPM concentrations. These data indicate the addition of 50% hPM to chondrogenic media was most effective in promoting chondrogenic differentiation. Future investigations will include analytical confirmation, with RT-PCR and hydroxyproline assays

25. Title: A Decoupled Multi-Stimulus Bioreactor for Studying Complex Chemo-Mechanical Microenvironments In Vitro

Authors: Bryan D. James, Nicholas Montoya, William Ruddick, Josephine B. Allen

Abstract: In the body, cells exist in a complex chemo-mechanical microenvironment, which works to regulate the cell's functional behavior. In recent years, many novel bioreactor systems have been developed to expose cells to individual stimuli such as fluid wall shear stress (WSS), cyclic stretching, hydrostatic pressure, substrate stiffness, substrate topography, and extracellular matrix proteins. These systems have led to the growing appreciation for the role mechanical forces have in regulating cellular behavior; however, few approaches are material independent and allow for the systematic variation of multiple combinations of forces in a single device. We have developed a unique, cost-efficient, bioreactor system for independently and dynamically varying WSS, flow regime, cyclic stretch, hydrostatic pressure, and cell culture substrate including the substrate's stiffness, topography, and extracellular matrix (ECM) components. The chamber featured a rectangular flow channel and a pair of perpendicularly oriented protruding struts for stretching. The location of the cell culture region (CCR) was determined from FEM simulations of the chamber defined as the region in which a near-uniform strain field developed. In stretching the chamber, the flow channel geometry dynamically changes resulting in a varying WSS over the CCR. By adjusting the inlet flow rate, we hypothesized we could compensate for this variation to realize a constant WSS during stretching. We simulated this using an inlet velocity of the form, $V_{in}=V_{ave}-A\sin(2\pi t+\phi)$. The variation in the WSS over the center of the CCR was minimized using an A of 19.5 mm/s and a of 100º. PA and collagen gels were successfully bonded to the PDMS chamber and supported strain transfer during stretching. The chamber promoted cell attachment to the CCR when conjugated with RGD peptide. The Universal MechanoTester™ is able to decouple mechanical forces for their independent control. The CCR allows for material independence from the chamber construction. Well-established conjugation chemistries enable this system to be used with various materials and ECM proteins. Moreover, it supports the testing of new approaches for material design, such as aptamer surface functionalization for cell capture under dynamic conditions. The Universal MechanoTester™ will advance the study of cellular behavior in complex chemo-mechanical microenvironments.

26. Title: in situ 3D studies of cancer biology and immunotherapy
Authors: A.J. Mcghee, E. O. McGhee, D.L. Hood, K.E. Van Meter, J.M. Urueña, P. P. Levings, W.G. Sawyer
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, including: epithelial cells, cancer cells (primary and immortalized), fibroblasts, endothelial cells, and T-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. An integrated confocal microscope and culture system for in situ 3D studies of cancer biology and immunotherapy provides unique measurements of immune cell invasion dynamics in 3D microtumors.

27. Title: Composite Microparticles for the Magnetically Triggered Delivery of Human Placental Proteins for Wound Healing
Authors: Olivia Lanier, Joseph Ficarrotta, Isaac Adjei, Dayita Wable, Chris Nacea, Camryn Lewis, Laura Castillo, Blanka Sharma, Peter McFetridge, Jon Dobson
Abstract: Vascularization is a critical to tissue engineering, and the induction of vasculogenesis and angiogenesis in vitro and in vivo has been demonstrated in our labs using proteins derived from the human placenta –human placental matrix (hPM). However, to maintain angiogenesis, hPM must be delivered in multiple boluses. The objective of this work is to develop a non-invasive, remotely triggered hPM delivery system that is able to sustain angiogenesis, in addition to adjusting release to the patient's changing physiological requirements in wound healing applications. The proposed system consists of polycaprolactone (PCL) microparticles encapsulating hPM and superparamagnetic iron oxide nanoparticles (SPIONs). Release of hPM is triggered by heat generated when the SPIONs are exposed to an alternating magnetic field (AMF), melting the PCL, thus enhancing the diffusion of hPM through the polymer. 31 commercially available SPIONs were quantitatively characterized and evaluated for their ability to produce heat in an AMF. In addition, different properties of the composite microparticles were evaluated such as molecular weight, hydrodynamic diameter, and percent of magnetic loading. Results thus far have shown significantly enhanced delivery of the proteins with application of the AMF compared to controls, resulting in a provisional patent. Mass spectrometry has shown that over 80% of the hPM proteins are delivered upon AMF application for two hours. Current studies are investigating the in vitro functionality of the released proteins in osteoblasts and endothelial cells.

28. Title: Polypeptide Synthesis by Photopolymerization of NCAs
Authors: Sofia L. Goodrich, Megan R. Hill, Rebecca A. Olson, Brent S. Sumerlin
Abstract: Polypeptides are essential components of life, making them of great interest for biomedical applications. Synthesis of well-defined high molecular weight (MW)polypeptides allows for increased access to an array of polymer architectures and functionality for biocompatible materials. Traditionally, polypeptides are synthesized via conventional ring-opening (ROP) polymerizations of N-carboxyanhydrides (NCA) via direct aminolysis with a

primary amine initiator. Advancements in light responsive NCA-derived polymers have only recently been investigated; opening up the possibility for biocompatible and degradable photo-produced polypeptides and biopolymers. However, setbacks in the current photoinitiated NCA ROP methods include long polymerization times, poor initiation, and lack of control over molecular weight due to the inability to achieve full deprotection of the initiating amine. Our work utilized 2-(2-nitrophenyl)propyloxycarbonyl (NPPOC), for “protection” of the amine initiator, to perform photoinitiated NCA ROP to achieve well-defined polypeptides. The use of NPPOC for photoinitiation resulted in faster release of nucleophilic amines then previously used 2-nitrobenzyl functional groups, due to the higher quantum yield, allowing for greater control in ROP. We demonstrated that photo-liberation of amines for NCA (PLANCA) ring-opening polymerization using HA-NPPOC and PEG-NPPOC gave spatiotemporal control over NCA polymerization without sacrificing narrow molecular weight distributions or substantial loss of MW control. The addition of 0.1 – 0.2 equiv. of non-nucleophilic base resulted in MWs closer to theoretical values and improved the retention of active chain-ends, enabling full chain-extension of the resulting polymers. Furthermore, PLANCA ROP was used to synthesize block copolypeptides for the first time. This work has significant potential in the synthesis of complex biomaterials using photolithography and 3D printing methods.

29. Title: Examining Nerve Regeneration in an Implanted Peripheral Nerve Interface

Authors: F. Sedwick, A. Czeiszperger, F. Garcia, E. Atkinson, B. Spearman, C. Kuliasha, A. Furniturewala, M. Yusufali, C. Schmidt, J. Judy, K.J. Otto

Abstract: Modern prosthetic devices can interface with neural tissue to record and use motor information allowing for brain controlled prosthetic movement and to transmit environmental sensory information allowing patient sensory experiences. Despite the increased fine-motor control of these neural interfacing prosthetics, movement of these devices is usually slow and non-fluid which is likely due in part to the limited information bandwidth available at the tissue-device interface. When limited information is traveling through the prosthetic computer system, large assumptions are made about a patient’s intended movement. One way to improve information bandwidth between the tissue and device for the amputee patient population is to develop a tissue-engineered electronic nerve interface (TEENI) which positions a dense array of recording sites in regenerating neural tissue. The regeneration of a peripheral nerve is a complex process. When an axon is initially severed, the healing process begins with Wallerian degeneration in the distal stump and axonal growth occurring in the proximal stump. Damaged, nonfunctional nerve is removed in the distal stump which helps establish an environment through which new nerve growth can occur over the course of weeks to months. Preparation and promotion of axon growth is executed by macrophages and Schwann cells with the support of extracellular matrix proteins such as laminin and collagen. In this case, a TEENI device, with a tissue-engineered hydrogel, can mimic extracellular matrix components to enhance regeneration through the device. This study is seeking to analyze nerve regeneration through the TEENI device in the distal end of the sciatic nerve two weeks post-operation. This work was sponsored by the Defense Advanced Research Projects Agency (DARPA) Biological Technologies Office (BTO) HAPTIX program under the auspices of Drs. Doug Weber and Eric Van Gieson through the DARPA Contracts Management Office, Pacific Cooperative Agreement: No. HR0011-15-2-0030

30. Title: Effect of Dopant on In Situ Polymerization of Poly(3,4-ethylenedioxythiophene) (PEDOT) in Central Nervous System

Authors: Adrienne E Widener, Jamie M Murbach, Kevin J Otto

Abstract: Nearly one billion people throughout the world are affected by neurological disease and injury [1]. Chronically implanted neural prostheses are used to treat these maladies; however, these neural prostheses fail over time due to the lack of a reliable neural interface stemming from the foreign body response which results in an inability to record and stimulate chronically. Recently, conductive polymers (CP) have been incorporated into neural interfaces because of their chemical stability and improved electrochemical properties. The conducting polymer, poly(3,4- ethylenedioxythiophene) (PEDOT), has previously been applied to neural interfaces because of its high stability and has been shown to decrease impedance magnitude, enhance charge storage capacity (CSC), and improve recording quality in vivo [2,3]. Dopant anions such as perchlorate (ClO4), p-toluenesulfonate (pTS), and polystyrene sulfonate (PSS) are incorporated into the backbone structure and change the morphology of CPs resulting in improved charge transport along the polymer backbone, increasing CSC and conductivity [4]. This study aims to determine the effect of incorporation of different dopants and dopant concentrations on conductivity, CSC, and impedance magnitude of in situ electrochemical polymerization of the conductive polymer, PEDOT, to improve the device-tissue interface.

Constant potentiostatic polymerization was performed to polymerize EDOT doped with either ClO4, PSS, or pTS. Electrochemical impedance spectroscopy (EIS) measurements were taken before and after electrochemical polymerization to assess the conductive behavior of electrodeposited PEDOT for neural device application. Through EIS, histology and microscopy techniques, in situ electrodeposited PEDOT of all dopants was shown to decrease impedance magnitude over all frequencies measured as compared to plain PtIr wire. In situ polymerization of 0.01M PEDOT:PSS results in polymers with higher conductivity and the largest decrease in impedance at 1 kHz frequency as compared to PEDOT:pTS and PEDOT:ClO4. Future studies include observing the effects of varying the dopant concentration of PEDOT:pTS and PEDOT:ClO4 on conductivity, charge storage capacity and impedance.

[1] Nearly 1 in 6 of world's population suffer from neurological disorders. UN report, UN News (2007).

[2] Wilks, SJ, AJ Woolley, L Ouyang, DC Martin, KJ Otto. In Vivo Polymerization of Poly(3,4-ehtylenedioxythiophene) (PEDOT) in Rodent Cerebral Cortex. IEEE. (2011)

[3] Ouyang, L, CL Shaw, CC Kuo, AL Griffin, DC Martin. In Vivo Polymerization of poly(3,4-ethylenedioxythiophene) in the living rat hippocampus does not cause a significant loss of performance in a delayed alternation task. J. Neural Eng. (2014)

31. Title: Molecular Scale Modifications of Thiol-ene Networks for Enhanced Macroscopic Properties

Authors: Scarlett Arencibia, Adriana Hernandez, Clayton Keene, Daniel Savin

Abstract: Thiol-ene networks (TENs) display exceptional thermomechanical properties such as low stress, uniform crosslink density, minimal chain end presence and high mechanical energy damping properties. It has been found that these TENs exhibit a wide range of glass transition temperatures (Tg) depending on the thiol and vinyl monomers used, along with a tunable Tg and increased toughness by incorporating isocyanates into these networks. Molecular level

modifications of TENs can impart additional function and improve overall macroscopic properties of these novel materials. In these studies, we incorporate azobenzene into the polymer network that results in TENs with photo-responsive properties. This then allows for microscopic self-healing upon isomerization of azobenzene polymer with UV-light. Additionally, Diels-Alder (DA) moieties can also be incorporated into TENs that act as sacrificial linkages as well as allow for molecular scale rehealing of the networks. These modifications result in self-healing materials with improved utility and versatility of TENs as energy damping materials.

32. Title: Effects of PSS Molecular Weight on Conductivity of Electropolymerized PEDOT:PSS Wires for Neural Stimulation
Authors: Alyssa Massais, Scott Thourson, Kevin Otto
Abstract: Neural stimulation can be used to treat diseases in the brain and improve physiological functions in peripheral nerves. However, current neural stimulation electrodes lack chronic stability and cannot target individual neurons. A conductive polymer called poly(3,4-ethylenedioxythiophene):Poly(sodium 4-styrenesulfonate) (PEDOT:PSS) is widely used to improve the neural-electrode interface. Thin PEDOT:PSS films have been shown to lower the electrode surface impedance and provide a softer, biocompatible interface. Additionally, smaller, microelectrodes can target single neural cells and may enhance chronic stability. Our lab is working on synthesizing a network of PEDOT:PSS microwires to interface with neurons in the body. The primary disadvantage of PEDOT:PSS is its relatively low electrical conductivity. PEDOT:PSS is composed of two oppositely charged polymers: PEDOT (conductive) and the counterion PSS (nonconductive). Although PSS is nonconductive, it is necessary to facilitate polymerization and balance the positive net charge of PEDOT. It is hypothesized that PEDOT:PSS electrical conductivity can be increased by lowering the molecular weight of PSS to improve the connective organization of PEDOT within a wire. PEDOT:PSS microwires roughly 2 x 100 µm were electropolymerized in an aqueous solution of 10 mM EDOT and 20 mM PSS, using two different molecular weights of PSS: 1.69 and 70 kDa. Conductivity was calculated by measuring the resistance and dimensions of PEDOT:PSS wires. Two-point probe resistance measurements were obtained by measuring current while sweeping voltage across each wire. Contact resistance was subtracted by performing measurements at multiple locations along each wire. Preliminary data indicates that PEDOT:PSS wires synthesized using a smaller PSS molecular weight of 1.69 kDa have higher conductivity compared to 70 kDa. Using PSS molecular weight to increase the conductivity of electropolymerized PEDOT:PSS could make smaller polymer wire electrodes feasible for single neuron targeting and improved chronic stability.

33. Title: Synthesis and Characterization of Self-Assembling ABC Triblock Co-polypeptides
Authors: Brooke E. Barnes, Taylor A. Jenkins, Lauren M. Stein, Robert T. Mathers, Daniel A. Savin
Abstract: Self- assembly behavior of ABC triblock co-polypeptide consisting of poly(ethylene oxide-b-(leucine-s-valine)-b-lysine) was examined via dynamic light scattering in dilute aqueous solution. Leucine is a hydrophobic, α- helix forming polypeptide that has been shown to exhibit a “zipper effect” in coiled-coil dimers. It was shown that this specific interaction afforded by the leucine zipper was able to dominate the thermodynamics of self-assembly through the side by side ordering of α-helices, which drove vesicle formation with only 6 wt.% hydrophobic content.

Additionally, it was shown that a multitude of assembly sizes and morphologies were attainable from a single polymer, dependent on the assembly preparation used. This system provides a facile route to formation of the leucine zipper in solution, lending to future studies of the effect of this assembly motif on classical self-assembly thermodynamics.

34. Title: Tuning the pKa of Poly(lysine): Enhancing Stimuli-Responsiveness of Peptide Block Copolymers
Authors: Abigail K. Nason, Brooke E. Barnes, Daniel A. Savin
Abstract: Herein we report the synthesis and characterization of a diblock polypeptide composed of poly(ethylene oxide-b-lysine), where the lysine block has been modified with an electron withdrawing group. The ε-amine of the lysine is modified utilizing a monomer modification approach prior to polymerization. We hypothesize that modifying the lysine monomer with an electron withdrawing group will tune the pKa of the resultant poly(lysine) block from pH 9 to a more biorelevant region (pH ~ 6-7). Incorporation into a diblock copolymer will imbue the system with enhanced functionality and pH responsiveness, where conformation changes in the lysine secondary structure may result in overall assembly morphology transitions. These copolymer systems can be utilized in areas such as drug delivery, whereby modified pH-responsve blocks can be incorporated into delivery vehicles where cargo can be spontaneously released upon pH driven morphology transitions.

35. Title: Magnetically Triggered Release of Active TGF-β From Spin Vortex Micro-discs
Authors: Obiora Azie, Keisha Castillo-Torres, Zachary Greenberg, David Arnold, Jon Dobson
Abstract: Transforming Growth Factor – β (TGF-β) has been implicated in a variety of cellular functions, including control of cell cycle, cell proliferation, extracellular matrix formation, and even stem cell differentiation (Sakaki-Yumoto et al., 2013). Unfortunately, TGF-β is also implicated in undesirable cellular responses, including cellular senescence, cellular apoptosis, and tumor progression. As such, spatial and temporal control of TGF-β delivery has the potential to minimize these off-target effects. We recently reported magnetically triggered release of active TGF-β from TGF-β Latent Complex conjugated to high-specific absorption rate (SAR) magnetic nanoparticles (Monsalve et al., 2015). While this technique has the potential for spatial and temporal control of release, the radiofrequency fields used to trigger activation were higher than those that are allowed for clinical exposure. In order to remedy this issue while still retaining precise control of TGF-β delivery, we have investigate triggered release of TGF-β from the latent complex conjugated to spin vortex discs (Kim et al., 2010). This approach eliminates the need for RF energy transfer to the particles as it relies on release due to shear stress from the mechanical motion of the discs in low frequency magnetic fields.

36. Title: Chronic evaluation of shape memory polymer nerve cuff electrodes
Authors: 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
Abstract: Shape-memory polymers (SMP) have enough rigidity at room temperature to be easily implanted, then soften upon implantation. This reduces mechanical mismatch between the device and surrounding tissue1,2, which has been shown to have a major impact on the foreign body response to implanted devices. The feasibility of thiol-ene/acrylate shape-memory nerve cuff

electrodes to be used for VNS has been previously demonstrated in vivo1. However, these studies were only evaluated over acute time periods, and the ability of these devices to function over chronic time-scales remains unknown. The chronic performance of SMA cuffs at the biological, material and electrochemical levels must be evaluated before they can be widely adopted for research, and eventually clinical, purposes. This work evaluates the electrochemical behavior of SMP nerve cuff electrodes implanted around the cervical vagus nerve via electrochemical impedance spectroscopy and voltage transient measurements. Impedance is a complex number composed of an imaginary and real part, which for this application corresponds to the capacitive and resistive components, respectively. Physical factors that contribute to the real component include purely resistive materials, such as
extracellular matrix, or fibrotic tissue that forms in response to the implanted device. Cell membranes have electrical behavior equivalent to a parallel RC circuit, and are the main contributing factor to the imaginary impedance. We found that the real and imaginary impedance components were stable for two to ten weeks post implant, then decreased at twelve weeks. Histological analysis of the implanted devices allowed electrochemical features to be compared to the biological response to the implants.

37. Title: Optimizing the PEGylation of Stable Galectin-1 Dimers
Authors: Fettis, Margaret; Kane, Bryant; Hudalla, Greg
Abstract: Galectins are a family of 15 carbohydrate binding proteins with immunomodulatory function. Galectin-1 (Gal-1) is a protein that demonstrated therapeutic potential for autoimmune conditions in pre-clinical models. One of the challenges of translating Gal-1 to a viable therapeutic candidate is for the protein to be active, it must be in the conformation of a homodimer, which is subject to dissociation at low but therapeutically relevant dosage of protein. Gal-1 has 4 surface cysteines which can cause oxidative inactivation of the protein, therefore, WT-Gal-1 must be placed in a reducing environment to conserve activity. To create a more stable dimer, 3 of the 4 surface cysteines (C2, C16, and C88) were mutated to serine, and two monomer units were cross-linked via reaction of C130 and polyethylene glycol (PEG) diacrylate. The result was a tri-mutant Galectin-1 protein resistant to inactivation in oxidative environments and active at concentrations 10x lower than un-“pegylated” proteins. C130 was used as the primary pegylation site for its proximity to the dimerization domain of the protein. We hypothesize that expressed protein variants containing C2, C16, and C88 residues respectively can also be pegylated to some degree. We also hypothesize that different PEG end group chemistries, such as PEG dimaleimide, and varying lengths of PEG base chain can be used in the linkage of the protein monomers.