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Abstracts

1. Joseph Decker- University of Florida

Engineered Antifouling Microtopographies: An Energetic Model That Predicts Cell Attachment

We have developed a model for the prediction of cell attachment to engineered microtopographies based on two previous models, the Attachment Point Theory and the Engineered Roughness Index (ERI) model. The new Surface Energetic Attachment (SEA) model is based on both the properties of the cell-material interface as well as the size and configuration of the topography relative to the organism. We have used Monte Carlo simulation to examine the SEA model's ability to predict relative attachment of the green alga Ulva linza to different locations within a unit cell. We have also compared the predicted relative attachment for Ulva linza, the brown alga Navicula incerta, the marine bacterium Cobetia marina and the barnacle cyprid B. amphitrite to a wide variety of microtopographies. We demonstrate good correlation between the experimental results and the model results for all tested experimental data, and thus show the SEA model may be used as a powerful indicator of the efficacy for antifouling topographies.

2. Manuel Salinas- Florida International University

Implications of Oscillatory Shear Stresses environments for Engineered Heart Valves

Studies suggest that oscillatory shear stress (OSS) caused by combined steady flow and scaffold flexure play a critical role in engineered heart valve tissue formation, secreted by bone marrow derived stem cells (BMSCs); yet the underlying mechanisms are not known. This study was aimed at uncovering such mechanisms by looking at the OSS created during valve like deformations.

Using Ansys CFX (Ansys Inc, Canonsburg, PA), the samples were assumed to adopt a parabolic shape and conform to an arc of fixed length. A one-way fluid structure interaction approach was used by incorporating the grid velocity to the momentum and continuity equations using the arbitrary Lagrange-Eulerian approach. Cyclic flexure was simulated at a frequency of 1 Hertz. Other parameters used were density of 1.01 g/cm3, viscosity of 1.27 cP, inlet velocity 2.2 cm/s and a zero outlet pressure. Following successful mesh independence, a structured mesh consisting of XX elements was used. Time and cyclic independence was also established and simulations subsequently run in the CFX environment up to XX time steps and XX cycles.

As the samples begin to bend, the magnitude of the shear stress increases on the sample walls. Maximum shear stress occurs at the vertex of the samples where flexural stresses are at their highest. The extent of oscillatory shear stress was high on the inner wall of the sample and is likely to have contributed towards synergistic

collagen formation previously observed experimentally.

OSS may contribute significantly towards the development of robust engineered heart valve tissues. In the long-term, insights derived from this research could identify co-relation of OSS distribution to enhanced engineered heart valve tissue secretion in vitro

3. Sasmita Rath- Florida International University

Mechanically-regulated gene expression in heart valve targeted tissue engineering studies.

Different tissues express different types of genes and proteins which are critical for their normal biological function. Here we discuss genes relevant for heart valve tissues engineering and which are modulated by their external mechanical environment. This study hypothesized that the application of oscillatory shear stress (OSS) induces BMMSCs to differentiate into valve endothelial cell (VEC) and valve smooth muscle cells (VSMC). In the first set of experiments, steady flow was applied on BMMSCs seeded into poly glycolic acid and poly lactic acid (PGA: PLA) blend polymer scaffold in a bioreactor environment for 14 days. Samples experiencing no stress (NS) were cultured in a regular 24 well plate and used as the control. At the end of the experiment cells were trypsinized from the scaffold and mRNA was extracted for gene expression measurement.

Quantitative real time polymerase chain reaction (qRT PCR) results revealed the expression of PECAM1, FLK1, VE-cadherin, TIE1 genes indicating presence of ECs whereas integrin beta1, THY1 genes indicating presence of SMCs in both NS and SS groups. However, the combination of lack of expression of MLC1F and robust expression of FZD2 was found only in the SS condition, which indicates a unique smooth muscle phenotype which is a characteristic expression only for heart valves and the pericardium. In addition, ALP expression indicative of calcification in heart valves was on the other hand not expressed at all, solely in the SS group.

Our preliminary results suggest that steady flow of cell culture media promoted the cardiovascular phenotypic expression of BMMSCs. We are currently exploring the utility of OSS in similar gene expression studies and particularly those genes (e.g. expression of FZD-2, TnTs, Klf2a and absence of MLC1f) that would point towards a distinct valvular phenotype.

4. Glenda Castellanos- Florida International University

Bone Marrow stem cells' deformation During Valve-Relevant Loading

The cell cytoskeleton consists of three primary components: actin filaments, intermediate filaments, and microtubules. The backbone of the cytoskeleton is F-actin which comes together to form filaments. Changes in the F-actin, are closely linked to gene expression and protein synthesis in the mechanobiology of stem cells. With the use of bone marrow stem cells (BMSc) we wished to examine the effect of cyclic flexure and fluid stresses on the cellular mechanical response, in the context of heart valve tissue engineering. Our objective was to observe BMSc differentiation towards a lineage-specific pathway, potentially demonstrating support for valvular phenotypes. Transfected BMSc, emitting a fluorescent signal in their F-actin protein structure, were cultured in a non-woven PGA-PLA (50:50) scaffold for 14 days.

The scaffold was later tested by an in situ micro load frame mounted on an inverted fluorescent microscope. The localized strain fields in the scaffold as well as the cellular deformation responses were subsequently monitored. We determined that the cytoskeletal structure was altered after loading was applied. We are currently linking these results to gene expression by the BMSc to identify the mechanisms by which cytoskeletal changes may lead to cellular differentiation, and potentially in support of engineering robust heart valve tissues.

5. Archana Chidambaram- University of Florida

Randall's plaque (RP) deposits seem to be consistent among the most common type of kidney stone formers, idiopathic calcium oxalate stone formers. This group forms calcium oxalate renal stones without any systemic symptoms, which contributes to the difficulty of understanding and treating this painful and recurring disease. Thus, the development of an in vitro model system to study idiopathic nephrolithiasis, beginning with RP pathogenesis, can help in identifying how plaques, and subsequently stones, form. One main theory of RP formation is that calcium phosphate deposits initially form in the basement membrane of the thin loops of Henle, which then fuse and spread into the interstitial tissue, and ultimately make their way across the urothelium, where upon exposure to the urine, the mineralized tissue serves as a nidus for overgrowth with calcium oxalate into a stone.

Our group has found that many of the unusual morphologies found in RP and stones, such as concentrically-laminated spherulites and mineralized collagenous tissue, can be reproduced in vitro using a polymer-induced liquid-precursor (PILP) process, in which acidic polypeptides induce a liquid-phase amorphous precursor to the mineral, yielding non-equilibrium crystal morphologies. Given that there are many acidic proteins and polysaccharides present in the renal tissue and urine, we have put for the hypothesis that the PILP system may be involved in urolithiasis.

Therefore, our goal is to develop an in vitro model system of these two stages of composite stone formation in order to study the role that various acidic macromolecules may play. In our initial experiments presented here, the development of "biomimetic" RP was investigated, which will then serve as a nidus for calcium oxalate overgrowth studies. In order to mimic the tissue environment, MatriStem® (ACell, Inc.), a decellularized porcine urinary bladder matrix was used, because it has both an intact epithelial basement membrane surface and a tunica propria layer, thus providing the two types of matrix constituents found associated with mineral in the early stages of RP formation. We found that when using the PILP process to mineralize this tissue matrix, the two sides led to dramatically different mineral textures, and they bore a striking resemblance to native RP, which was not seen in the tissue mineralized via the classical crystal nucleation and growth process.

The interstitium side predominantly consisted of collagen associated mineral, while the luminal side had much less mineral, which appeared to be tiny spherules embedded within the basement membrane. Although these studies are only preliminary, they support our hypothesis that kidney stones may involve non-classical crystallization pathways induced by the large variety of macromolecular

species in the urinary environment. We believe that mineralization of native tissue scaffolds is useful for developing a model system of stone formation, with the ultimate goal of developing strategies to avoid RP and its detrimental consequences in stone formation, or developing therapeutic treatments to prevent or cure the disease.

6. Ismail Ocsoy- University of Florida

The conversion of protein to peptides without missed cleavage and identification and quantitation of them have been greatly focused in the research of proteomics to elucidate genomic sequence and cancer biomarkers. Several strategies have been offered and tested to reach rapid, sensitive and complete protein digestion methods. However, several limitation in protein digestion reaction have not been overcome yet with current techniques such as long reaction time, limited mass transfer between enzyme and substrate and limited sensitivity. Herein, we report trypsin enzyme based flower shaped NMs to efficiently digest target protein with enhanced enzymatic activity generated by synergistic effect. Trypsin nanoflowers (NFs) also shorten protein digestion time and minimize trypsin autolysis due compact structure of trypsin flower compared to trypsin itself and trypsin-NMs conjugates.

7. Makensley Lordeus- Florida International University

A Graphene Reinforced Silicone Composite Material for Artificial Heart Valves

Heart Valve disease is a prevalent clinical problem in the United States. When one of the heart valves fails, it could be replaced with an artificial heart valve. In many cases, a mechanical heart valve is used due to their durability. Patients with mechanical heart valves however have to take lifelong anticoagulants to prevent risk of thrombus. Emerging, elastomer heart valves have been shown to be able to better recreate the flow physics of native heart valves, resulting in preferable hemodynamic responses. Unfortunately, elastomers, such as silicone, are prone to structural failure due to its poor tear strength which drastically limits their applicability to heart valve prosthetic development.

In this study we reinforced silicone with graphene nanoplatelets. Graphene is a high strength material available in many forms. The nanoplatelets were introduced into a 2 part silicone mixture and allowed to cure. Three concentrations of graphene and silicone were tested: 250 mg, 75 mg, and 25mg of graphene per liter of uncured silicone. The mechanical and cytotoxic properties of the graphene-silicone composite material were subsequently characterized using tensile testing and a SRB assay respectively.

The introduction of graphene to silicone altered the tensile properties of the elastomer. At 20 % strain, the control sample had a Young's Modulus of 0.69 MPa; the samples containing 250mg, 75 mg, and 25mg of graphene per liter of uncured silicone had a Young's Modulus of 0.85 MPa, 0.67 MPa, and 0.78 MPa, respectively. The SRB assay further showed that the graphene did not in any way inhibit the growth of endothelial cells. However, further testing of the silicone-graphene composite materials will be necessary in order to establish a clear pattern of

improvement to their mechanical properties over silicone alone, to be considered beneficial for the artificial heart valve application; these tests are currently underway in our laboratories.

8. Dua Rupak- Florida International University

Interfacial strength properties between stem cell and chondrocyte derived tissue matrices using hydroxyapatite nanoparticles

Articular cartilage defects are the end result of knee injuries and/or osteoarthritis. Injury can incite mild to moderate levels of osteoarthritis over time. Among regenerative strategies that have been implemented to treat these defects, in vitro culture of engineered cartilage constructs for subsequent implantation has shown great promise. However approaches to improve upon integration outcomes for the engineered construct to surrounding host tissues, i.e. the subchondral bone and adjacent native articular cartilage are severely lacking. We previously reported on the use of Hydroxyapatite (HA) nanoparticles to promote engineered cartilage to bone matrix integration.

Here, by employing a similar strategy, we investigated the effectiveness of integrating tissue engineered cartilage derived from HBMSCs to healthy as well as diseased cartilage mimics in an in vitro engineered tissue model system. Improvement in integration using HA was specifically assessed via the integration strength between marrow stem-cell secreted tissue engineered cartilage and healthy and diseased cartilage matrix derived from human chondrocytes. At the same time, we also evaluated the phenotypic stability of the marrow cell-derived engineered cartilage at locations distal and proximal to the interface, both within the side of the stem cell-derived matrix. A significant finding was that there was ahigher ($p<0.05$) interfacial shear strength between the tissue engineered cartilage derived from HBMSC with HA particles and the osteoarthritic chondrocyte-secreted matrix (as compared to the without HA counterparts). These findings indicate that the HA-rich environment permits more effective integration between cartilaginous tissues and therefore is of importance to facilitating improvements to tissue engineered cartilage integration.

9. Maeve Budi- University of Florida

Multiferroic Janus Fibers for Bioapplications

Electric fields play a large role within the human body, influencing a wide variety of functions, from ion channel signaling to neural growth and tissue regeneration. However, due to the attenuating nature of human tissue, delivering localized electric fields within the body typically requires invasive surgeries. Multiferroic composites, specifically those exhibiting the magnetoelectric effect, offer a unique opportunity to overcome this problem. In these multiferroic composites piezoelectric and magnetostrictive materials are coupled via strain transfer across a common interface, through which an applied magnetic field can elicit a spontaneous electric polarization.

Since magnetic fields can propagate through the body with minimal interference such a system holds promise for biomedical applications. However, there are several factors that limit the application of magnetoelectric composites to

biomedical applications. One factor is that to date many of the compounds in conventional magnetoelectric composites (e.g., lead zirconate titanate, barium titanate) raise toxicity concerns. Additionally, much of the work in magnetoelectric composites has focused on bulk systems, which preclude their use in in vivo applications.

Here, we will present on the development of magnetoelectric nanomaterials with increased biocompatibility. Bismuth ferrite (BiFeO3) is used as the piezoelectric component and cobalt ferrite (CoFe2O4) as the magnetostrictive component. Nanofibers were created via electrospinning, which allows for relatively rapid and cheap generation of nanomaterials. Here, we will report on the successful fabrication of BiFeO3-CoFe2O4 multiferroic fibers in a Janus type arrangement. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) were used to verify the structure and composition of the fibers and X-ray diffraction (XRD) was used to confirm the presence of BiFeO3 and CoFe2O4 present after calcination.

10. Michael Eden- Florida International University

Incorporation of Photo-Carbon Monoxide Releasing Materials into Electrospun Scaffolds for Vascular Graft Application

Carbon monoxide (CO) has been shown to have cardioprotective properties. This includes enhancing re-endothelialization and improving graft survival in mice and rats. A promising strategy is to release the CO locally using CO releasing materials (CORMs). In this study we use visible light activated photoCORMs (i.e., unsaturated cyclic α-diketones) with electrospun scaffolds as a carrier. These CORMs allow us to control the release of CO by activation with visible light, and provide a simple, nondestructive method to track the extent of photo reaction and CO release through fluorescence. The electrospun scaffolds provide a good hydrophobic carrier for the photoCORM, which is required for high CO yield.

We produced electrospun poly (ε-caprolactone) (PCL) scaffolds with and without CORMs using a 90% v/v chloroform / dimethylformamide solution, and characterized the scaffolds with SEM. We found that the presence of the CORMs (2% w/w CORM / PCL) reduced the average fiber diameter from 1.75±0.41 to 1.32±0.49 for a 20% w/v electrospinning solution. We verified the release of CO by measuring a linear increase in fluorescent intensity of the CORM at 350 nm excitation after 90 s of activation with 450nm light. Light for activation was provided for 15 s at a time up to a total of 10 min, with measurements taken in between. We modified a previously developed protocol for use with electrospun meshes [3]. We are currently performing a study to determine if meshes loaded with CORMs release CO in aqueous medium. This is necessary because it has been shown that this CORM molecule loses its ability to be activated in response to light when it is in aqueous medium. We will be testing different time points to determine if water penetrating the electrospun fibers will reduce the release efficiency of the CO.

Overall, our initial findings show that the photoCORM is functional when incorporated into electrospun PCL meshes and that we can control the release through irradiation time. Our system represents a promising strategy for controlled delivery of CO to enhance graft endothelialization.

11. Kelsey Crannell- University of Florida

Polymer-based Nanocomposite for the Early Detection of Lung Cancer

lung cancer is detected at an early stage, prior to metastasis, it is a treatable, if not curable disease. However, current methods for the early diagnosis of lung cancer are highly invasive and/or unreliable. This project seeks to overcome these limitations through the development of a non-invasive, rapid and early detection method for lung cancer. A biocompatible polymer reacted with a peptide creates a network of crosslinks upon curing enabling the encapsulation of luminescent silicon nanoparticles. In the presence of MMP-2, a protease that is overexpressed by cancerous cells, the peptide will cleave, releasing the silicon nanoparticles, which will then be cleared through the kidneys and into the urine, where they can be detected. Monodisperse microparticles of the polymer with the incorporated peptide will be prepared via inverse emulsion methods. Physical properties of the polymer particles, including mesh size and crosslink density, were obtained by measuring their diameter via optical microscopy in different stages of processing. Cytotoxicity and degradation of these polymer-peptide microparticles has also been examined using the A549 cell line, a human epithelial cell line derived from lung carcinomatous tissue that produces MMP-2 over time.

12. Jason Rosen- University of Florida

Influencing Neural Progenitor Cell Fates with Hydrogel Scaffolds

Most of the effects of Parkinson's disease have been shown to result from the idiopathic death of dopaminergic neurons in the brain. As such, ongoing research is investigating a mechanism to deliver dopaminergic neurons to the dopamine depleted brain. Neural progenitor cells (NPCs) have shown therapeutic potential for the treatment of neurological diseases such as Parkinson's disease. However, NPCs are multipotent and have the ability to differentiate into neurons, astrocytes, and oligodendrocytes. There is thus a need to guide NPC differentiation to encourage the formation of dopaminergic neurons. This study makes use of a 3D hydrogel scaffold to encapsulate the cells, creating a biomimetic environment to encourage cell viability and differentiation.

Hydrogels were synthesized by mixing hyaluronic acid (HA), collagen and laminin, made to mimic the mechanical properties of the native brain. NPCs were harvested from timed pregnant mice and were grown as neurospheres. Either primary or passaged (P2-P4) NPCs were encapsulated in hydrogels (density 200,000 cells/30 μL of gel solution) and cultured in a DMEM/F12 media supplemented with N2 with 1% FBS. Cells were also cultured on top of the hydrogels, mimicking a 2D system (density 30,000 cells/12 mm gel) for comparison. Immunocytochemistry was used to identify undifferentiated cells (nestin), neurons (βIII tubulin), dopaminergic neurons (TH), serotonergic neurons (5HT), and astrocytes (GFAP). Labeled cells were observed and photographed using fluorescent microscopy, and a ratio of each cell type to the total number of cells (DAPI) was determined.

Preliminary results suggest that we have successfully developed a model to encourage NPCs to differentiate into dopaminergic neurons. Overall, cells

encapsulated in 3D hydrogels yielded more dopaminergic neurons than cells cultured in 2D systems. The addition of laminin and HA to the hydrogel system further enhanced differentiation when compared to collagen-based gels.

This study demonstrated the utility of HA-based hydrogels that encapsulate cells to create a 3D environment that both mechanically and chemically mimics the native brain. Further research must be done that observes both the efficacy of cell delivery as well as hydrogel degradation in mouse transplantation studies.

13. Erik Price- University of Florida

Synthesis and Characterization of Biorenewable Aromatic Polyacetal Copolymers

In the world of polymer chemistry, biorenewable polymers are a field that has exploded in popularity in the last few decades. However, degradability is a whole other issue. Several bioderived polymers are available nowadays, but their degradability is limited. Taking both of these characteristics into account, polyacetals are a potentially fruitful avenue of research to pursue. The fascinating characteristic of polyacetals are their degradability in acidic media.

The monomers utilized in these reactions are a dialdehyde and appropriate tetraols. The dialdehyde utilized is composed of two vanillin molecules paired by a two-carbon spacer, creating Vanillin-2-Vanillin, commonly referred to as V2V.

The tetrols utilized are Pentaerythritol (PE) and di-trimethylolpropane (di-TMP). PE is simply two diols paired by a quaternary carbon, while di-TMP contains two diols paired with two quaternary carbons linked by an ether bond. By loading different ratios of the two tetraols, we can obtain a set of copolymers with tailored thermal and mechanical properties, as well as differential degradability.

14. Matthew Carstens- University of Florida

Colorectal cancer is the third most common cancer worldwide. In all cancers, it is becoming increasingly evident that simultaneously targeting multiple critical pathways, using combinations of chemotherapeutic drugs, can enhance outcomes. To date, however, oncologists lack the tools necessary to predict the success of combination treatments from patient to patient because sensitivity of cancers to various classes of chemotherapeutics is highly variable, due in part to intratumor heterogeneity. Recent findings attribute this heterogeneity to a small population of multipotent cells, or cancer stem cells (CSCs). One approach to address this issue, described herein, involves fabrication of a miniaturized platform to which CSCs can adhere and be exposed to unique treatment conditions. Using this method, colorectal CSCs isolated from two different patients exhibited unique responses to drug combinations when cultured on the microarray, highlighting its potential utility as a prognostic tool for identifying effective, personalized chemotherapeutic regimens.

15. Cary Kuliasha- University of Florida

Random Acrylate Copolymer Surface Grafting to Poly(dimethyl siloxane) Elastomer Surfaces for Improved Anti-Biofouling.

Random copolymers of acrylic acid, acrylamide, and methyl acrylate have been chemically grafted to poly(dimethyl siloxane) elastomer (PDMSe) surfaces through the use of 3-mercaptopropyl trimethoxysilane as a silane coupling agent in conjunction with thiol chain transfer and surface initiated chain growth radical polymerization. Acrylate modified PDMSe surfaces exhibit sessile water drop contact angles of 48±4° and surface free energy of 49±6mN/m. FTIR-ATR and XPS analysis has identified characteristic acrylate peaks on grafted surfaces. Acrylate grafted PDMSe surfaces provide a 75% reduction in attachment density of the algae zoospore *Ulva linza* compared to unmodified PDMSe. No additional reduction in attachment density has been found with the addition of microtopographies.

16. Cassandra Juran- University of Florida

Laser Micro-Patterned Xenogenic Fibrocartilage Scaffold for the purpose of Temporomandibular Disc Tissue Engineering.

The Temporomandibular Joint (TMJ) disc is susceptible to numerous pathologies that may lead to structural degradation and jaw dysfunction. The limited treatment options and debilitating nature of severe Temporomandibular Disorders has been the primary driving force for the introduction and development of TMJ disc Tissue Engineering as an approach to alleviate this priority clinical issue. This study aimed to evaluate the efficacy of cellular integration into an acellular laser micro-patterned (LMP) freeze-dried porcine TMJ disc scaffold. The LMP is incorporated into the scaffold using a 40W CO2 laser ablation system to drill a 10by10 pattern of 80μm holes. After gamma irradiation sterilization the scaffolds were seeded with 0.75x10^5 fibrochondrocytes/sample and either traditionally or periodic compressive stimulation cultured for 1, 7, and 21 days. The histology, cell proliferation (PicoGreen DNA quantification), and cell metabolism (BrUTP-FuGENE 6 assay) results of these works indicate that the LMP scaffold allow better cellular remodeling than the unworked scaffold over the 21 day culture. Also, the compressive biomechanical ability of the LMP cellularized scaffold cultured with compressive stimulation more closely represents the native mechanics than the non-stimulated cellularized scaffolds. The LMP TMJ disc scaffold is a promising scaffold for recapitulating the native TMJ disc characteristics.

17. Aurore Van de Walle- University of Florida

The Human Umbilical Vein for Small Diameter Vascular Bypass: from Acellular Scaffold to Functional Graft

The clinical demand for viable small diameter bypass grafts has driven development of 'living' blood vessel substitutes. Acellular tissues are currently used as scaffolds to guide cell repopulation toward graft remodeling and functionalization. Over the past 10-15 years, numerous studies have assessed reseeded ex vivo constructs; however, mass transport limitations in concert with subcellular pore geometries minimizes cell penetration and typically results in cells limited to the construct periphery (in vitro). Based on previous studies, these investigations focus on the use of directed nutrient gradients to enhance cell migration leading to fully repopulated, cell dense, constructs with wall thicknesses exceeding 500 μm.

18. Shanna Smith- University of Florida

Polymer Therapies for Treating Pediatric Osteosarcoma

19. Adam Monsalve- University of Florida

Controlling Single cells and Cell Populations Using Magnetic Materials and Applied Fields

Magnetic fields are capable of passing through the human body, due to its largely diamagnetic nature. A great deal of current biomaterials research focuses on utilizing the unique properties of these materials to control cellular function in the body. In this work, we show how using various geometries of magnetic field sources can allow for the control over individual cells or large populations of cells.

20. Clayton Argenbright- University of Florida

Engineered Hierarchical Topographies Using Block Copolymer Masks for Antifouling Surfaces

Biofouling, the accumulation of biological and organic matter on a surface, is a complex process involving a wide variety of materials and organisms. It begins with the adsorption of proteins and other molecules on the surface. These are followed by bacteria and small cells, then by larger microscopic and finally macroscopic organisms. This has major consequences for the medical and marine industries. Many techniques have been used in the past to disrupt this process. Most notably, biocidal paints have been successful at reducing fouling on the hulls of ships, but can leech toxins into the surrounding environment. The current focus in this field is on environmentally neutral antifouling strategies. Surface chemistries and topographies have already been proven to deter certain fouling organisms. Unfortunately these surfaces have only been effective for the specific organisms that they are designed for. For most practical applications a universally effective antifouling surface is needed. Organisms of different sizes require topographies of different sizes to be influenced. The same can be said for surface energy and chemistry, while a surface may reduce fouling of one organism, it could enhance fouling of another. Using block copolymers , multiple antifouling strategies can be combined to create surfaces capable of interacting with a variety of organisms. Block copolymers naturally self assemble into various phase segregated morphologies if the blocks are chemically dissimilar. This phenomenon is used to create surface patterns on the nanoscale. Through further processing this can be used to create chemical patterns, patterned polymeric grafts, or hierarchical patterns and topographies.

21. Ruitong Xiong- University of Florida

Jet-based 3D Printing of Biological Constructs

Organ printing is the layer-by-layer bottom-up fabrication of complex cellular organization of native tissues or organs by bioprinting of 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 US 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, there is a critical need 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. Both inkjet- and laser- based bioprinting technologies have been explored as enabling bioprinting technologies, and some complex constructs such as 3D vascular and vascular-like constructs have been successfully fabricated.