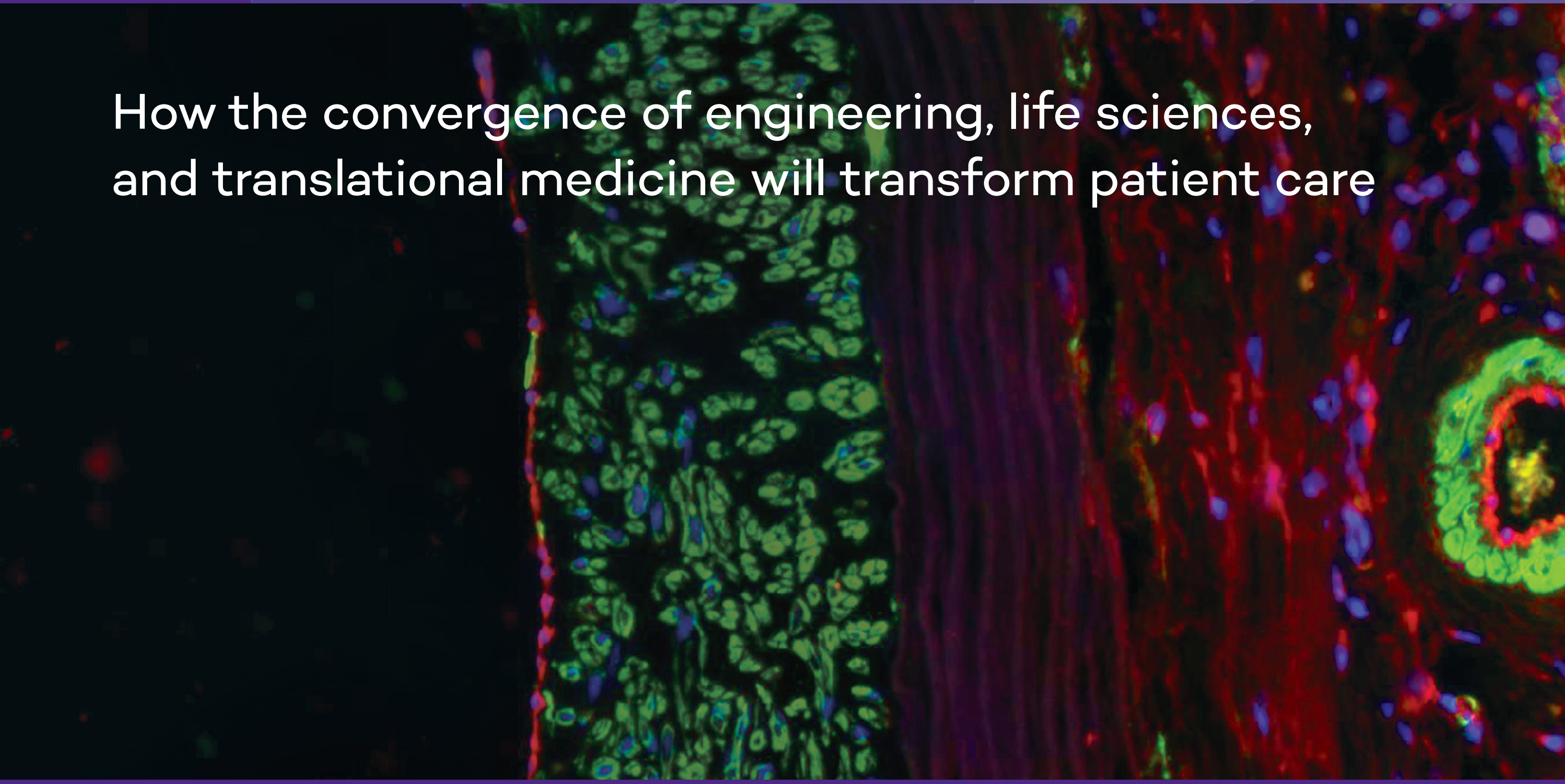
Northwestern | CENTER FOR ADVANCED REGENERATIVE ENGINEERING

SYMPOSIUM ON REGENERATIVE ENGINEERING

How the convergence of engineering, life sciences, and translational medicine will transform patient care



Thursday, May 31, 2018
8:30 am - 6:30 pm

Prentice Women's Hospital
South Auditorium, 3rd Floor
250 E. Superior Street
Chicago, IL

Northwestern
CENTER FOR ADVANCED
REGENERATIVE ENGINEERING

Dear colleagues and guests,

Welcome to the inaugural Symposium on Regenerative Engineering, the launch event of the Center for Advanced Regenerative Engineering (CARE). These are exciting times to be involved in health-related research and technology development, as we are on the verge of a revolution in healthcare practice that will positively impact patient outcome across many diseases. This revolution is due to major innovations and breakthroughs in biology, chemistry, engineering, data science, and information technology. Despite these advances, very compelling healthcare challenges remain, some of which will require the deep integration of substantially different disciplines resulting in new frameworks that enable unprecedented solutions. Societal healthcare challenges that are the focus of CARE include the shortage of healthy donor tissues and organs and the limited ability of our body to regenerate after injury or disease, leading to high morbidity, mortality, and healthcare costs.

Although tissue engineering and regenerative medicine have emerged over the last three decades as fields that should overcome these challenges, they have not delivered the expected results that are required for widespread adoption by clinicians and industry. Therefore, a new strategy and corresponding ecosystem is required, one that redefines how we think about the nature of collaborations. Our nation's thought leaders at the United States National Academies have recently recognized that the implementation of convergence research will be key to solving our most challenging societal needs. Convergence research employs a diverse transdisciplinary approach to solve a target, highly complex problem. To this end, regenerative engineering is a new field defined as the convergence of advanced materials science, stem cell and developmental biology, physical sciences, and translational medicine to regenerate or reconstruct tissues and organs. CARE was envisioned as a mechanism to embody and implement the goals of regenerative engineering by bringing together disciplines and institutions here in Chicagoland to improve our community.

You will hear from world-class leaders in various research areas that are foundational to regenerative engineering and learn *how the convergence of engineering, life sciences, and translational medicine will transform patient care*, the topic of this symposium. A common theme is understanding and controlling the interactions between materials and cells to improve device, tissue, and organ function across several body systems. I sincerely hope that you enjoy the conference and join our efforts to reduce patient morbidity and mortality due to tissue or organ dysfunction. I invite you to join our Regenerative Engineering Society, which is open to all people, and to learn more about CARE at care.northwestern.edu.

Best wishes,

Guillermo Ameer, Sc.D.
Director, Center for Advanced Regenerative Engineering
Daniel Hale Williams Professor of Biomedical Engineering and Surgery

Robert R. McCormick School of Engineering and Applied Science, and
Feinberg School of Medicine, Northwestern University

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care.northwestern.edu

Dear colleagues,

It is my pleasure to welcome you to Northwestern University and to celebrate the launch of the new Center for Advanced Regenerative Engineering (CARE). We are proud of this new initiative in an emerging high-impact area of research.

This new center embodies the best of Northwestern's strengths in interdisciplinary collaboration and innovation. CARE brings together a broad range of researchers from multiple institutions to advance tissue and organ regeneration.

The McCormick School of Engineering is proud to be the home for CARE. It is my sincere hope that this symposium catalyzes many long-run research interactions that bridge our many disciplines and institutions.

My very best wishes for a highly successful symposium.

Sincerely,

Julio M. Ottino, Ph.D.
Dean, Distinguished Robert R. McCormick Institute Professor and Walter P. Murphy Professor of Chemical and Biological Engineering

Robert R. McCormick School of Engineering and Applied Science, Northwestern University

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PROGRAM

Thursday, May 31, 2018

Prentice Women's Hospital, South Auditorium, 3rd Floor, 250 E. Superior Street, Chicago, IL

7:30 - 8:30 am	**REGISTRATION/BREAKFAST**	
8:30 - 9:00 am	**OPENING REMARKS** **Guillermo Ameer, Sc.D.** Director, Center for Advanced Regenerative Engineering **Julio M. Ottino, Ph.D.** Dean, Robert R. McCormick School of Engineering and Applied Science **Nathaniel J. Soper, M.D., FACS** Chair, Department of Surgery, Feinberg School of Medicine **Debashish Chakravarthy, Ph.D.** VP Scientific Affairs Medline Skin and Woundcare Division	Medline Industries, Inc.
9:00 - 9:05 am	**SPEAKER INTRODUCTION: Guillermo Ameer, Sc.D.**	Northwestern University
9:05 - 9:45 am	**Teresa K. Woodruff, Ph.D.** Fertility Restoration	Northwestern University
9:45 - 9:50 am	**SPEAKER INTRODUCTION: Guillermo Ameer, Sc.D.**	
9:50 - 10:30 am	**Antonios G. Mikos, Ph.D.** Tissue Regeneration	Rice University
10:30 - 10:40 am	**BREAK**	
10:40 - 10:45 am	**SPEAKER INTRODUCTION: Jason Wertheim, M.D., Ph.D.**	Feinberg School of Medicine
10:45 - 11:25 am	**Nenad Bursac, Ph.D.** Muscle Regeneration	Duke University
11:25 - 11:30 am	**SPEAKER INTRODUCTION: Jason Wertheim, M.D., Ph.D.**	
11:30 am - 12:10 pm	**Jian Yang, Ph.D.** Bone Regeneration	Pennsylvania State University
12:10 - 1:15 pm	**LUNCH BREAK AND POSTER SESSION**	
1:15 - 1:20 pm	**SPEAKER INTRODUCTION: Guillermo Ameer, Sc.D.**	
1:20 - 2:00 pm	**Christine E. Schmidt, Ph.D.** Nerve Regeneration	University of Florida
2:00 - 2:05 pm	**SPEAKER INTRODUCTION: Guillermo Ameer, Sc.D.**	
2:05 - 2:45 pm	**Cherie L. Stabler, Ph.D.** Islet Function Restoration	University of Florida
2:45 - 3:00 pm	**BREAK**	
3:00 - 3:05 pm	**SPEAKER INTRODUCTION: Bin Jiang, Ph.D.**	Northwestern University
3:05 - 3:45 pm	**Raphael Lee, MS (BmE), MD, ScD, DSc (hon)** Wound Regeneration	University of Chicago
3:45 - 3:50 pm	**SPEAKER INTRODUCTION: Bin Jiang, Ph.D.**	
3:50 - 4:30 pm	**Karen Christman, Ph.D.** Heart Regeneration	UC San Diego
4:30 - 5:15 pm	**PANEL DISCUSSION: Implementing Regenerative Engineering For Maximum Impact** **Panel Moderator: Guillermo Ameer, Sc.D.** **Cato T. Laurencin, M.D., Ph.D.** **Debashish Chakravarthy, Ph.D.** **Richard T. Tran, Ph.D.**	 Northwestern University University of Connecticut Medline Industries, Inc. Acuitive Technologies, Inc.
5:15 - 6:30 pm	**RECEPTION AND POSTER SESSION**	
6:30 pm	**CLOSING REMARKS**	

The Symposium on Regenerative Engineering is sponsored by:

Northwestern | CENTER FOR ADVANCED REGENERATIVE ENGINEERING

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Biomedical Engineering

SPEAKERS

Teresa K. Woodruff, Ph.D.

Dean, The Graduate School, Northwestern University; Thomas J. Watkins Professor of Obstetrics and Gynecology, Feinberg School of Medicine; Professor of Biomedical Engineering, McCormick School of Engineering; Chief, Division of Reproductive Science in Medicine; Director, Center for Reproductive Science

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BIOGRAPHY

Teresa K. Woodruff Ph.D. is the Dean and Associate Provost for Graduate Education in The Graduate School at Northwestern University. She is also the Thomas J. Watkins Professor of Obstetrics & Gynecology, the Vice Chair for Research and the Chief of the Division of Reproductive Science in Medicine in the Department of Obstetrics and Gynecology, Feinberg School of Medicine. She is Professor of Molecular Biosciences in the Weinberg College of Arts and Sciences, and Professor of Biomedical Engineering in the McCormick School of Engineering. She is the Director of the Center for Reproductive Science (CRS), Founder and Director of the Women's Health Research Institute (WHRI), and Director of the Oncofertility Consortium. She is an internationally recognized expert in ovarian biology and, in 2006, coined the term "oncofertility" to describe the merging of two fields: oncology and fertility. She now heads the Oncofertility Consortium, an interdisciplinary team of biomedical and social scientist experts from across the country. She has been active in education not only at the professional level but also with high school students. To this end, she founded and directs the Oncofertility Saturday Academy (OSA), one of several high school outreach programs that engages girls in basic and medical sciences. She was awarded the Presidential Award for Excellence in Science Mentoring in an oval office ceremony by President Obama (2011). Widely recognized for her work, Woodruff holds 10 U.S. Patents, and in 2013 she was named to *Time* magazine's 'Most Influential Persons' list. Some of her recent awards and honors include a Guggenheim Fellowship (2017), a National Academy of Inventors Fellowship (2017), the Society for Endocrinology Transatlantic Medal (2017), and a Leadership Award from the Endocrine Society (2017). She has two honorary degrees including one from the University of Birmingham, College of Medical, UK (2016). She is an elected fellow of the American Institute of Medical and Biological Engineering and the American Association for the Advancement of Science (AAAS). She is past-president of the Endocrine Society and championed the new NIH policy that mandates the use of females in fundamental research. She is civically active and is an elected member of The Economic Club of Chicago and on the school board of the Chicago-based Young Women's Leadership Charter School.

A Transplanted Ovarian Bioprosthesis Created From 3D Printed Hydrogel Scaffolds with Microporous Architectures Supports Estrous Cycles, Ovulation, Live Birth and Lactation

ABSTRACT

Organ spheroids, such as ovarian follicles made of the potential egg cell and hormone-secreting cells, require a multidimensional physical environment to provide physical scaffolding and maintain signaling. Here, we invented a thermal-crosslinking method to create an ink that could be printed with a bioinspired architecture. We discovered a specific geometry (trapezoidal pores as opposed to square pores) that supported follicle differentiation and ovulation in a dish. We then down-selected and used the trapezoidal for in vivo studies. A transplant-scale ovarian bioprosthesis was seeded with green fluorescent protein (GFP) immature ovarian follicles and transplanted into the ovarian bursa of GFP-negative mice whose ovaries were removed. The otherwise sterile mice resumed hormone cycles, then ovulated, and we obtained live, GFP-positive pups that were supported by the lactating mom. Since lactation is dependent on ovarian follicles, the ovarian bioprosthesis remained functional beyond the initial re-establishment of the reproductive axis. One of the offspring from the transplant was mated and he is also fertile. The development of the first long-term functional ovarian bioproesthesis is important to oncofertility patients and is a technique that may inform other soft tissue engineering.

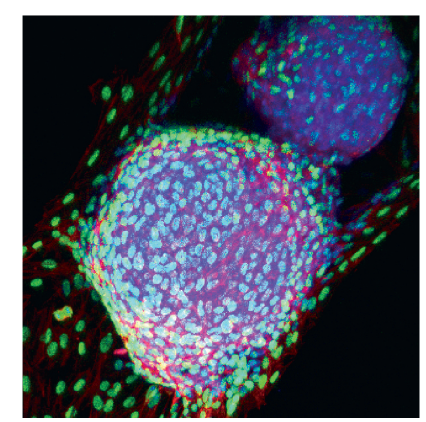

FIGURE: Image of mouse follicles within a 3D printed scaffold that supports follicle growth and oocyte development. When the follicle scaffold are transplanted into sterilized mice, they support integration with the host and live offspring. This image is of a whole mount immunostain for HMGB1 (green) with counterstain for actin (red) and DNA (blue) to show interaction between the follicle and the surrounding stoma-scaffold. The image is courtesy of Monica Laronda and Teresa Woodruff, Northwestern University in collaboration with Alex Rutz, Ramille Shah and other colleagues and reprinted by courtesy of Nat Comm, 2017 8:15261.

Antonios G. Mikos, Ph.D.

Louis Calder Professor of Bioengineering, Chemical and Biomolecular Engineering, Rice University;
Director, Center for Engineering Complex Tissues; Director, Center for Excellence in Tissue Engineering;
Director, J.W. Cox Laboratory for Biomedical Engineering

mikos@rice.edu

BIOGRAPHY

Antonios G. Mikos is the Louis Calder Professor of Bioengineering and Chemical and Biomolecular Engineering at Rice University. He is the Director of the National Institutes of Health Center for Engineering Complex Tissues, the Director of the Center for Excellence in Tissue Engineering, and the Director of the J.W. Cox Laboratory for Biomedical Engineering at Rice University. His research focuses on the synthesis, processing, and evaluation of new biomaterials for use as scaffolds for tissue engineering, as carriers for controlled drug delivery, and as non-viral vectors for gene therapy. His work has led to the development of novel orthopaedic, dental, cardiovascular, neurologic, and ophthalmologic biomaterials. He is the author of over 580 publications and the inventor of 29 patents. He is organizer of the continuing education course *Advances in Tissue Engineering* offered annually at Rice University since 1993.

Mikos is a Member of the National Academy of Engineering, the National Academy of Medicine, the National Academy of Inventors, the Academy of Medicine, Engineering and Science of Texas, and the Academy of Athens. He has been recognized by various awards including the *Lifetime Achievement Award* of the Tissue Engineering and Regenerative Medicine International Society-Americas, the *Founders Award* of the Society For Biomaterials, the *Robert A. Pritzker Distinguished Lecturer Award* of the Biomedical Engineering Society, and the *Marshall R. Urist Award for Excellence in Tissue Regeneration Research* of the Orthopaedic Research Society. He is a founding editor and editor-in-chief of the journal *Tissue Engineering*, and Past-President of the Tissue Engineering and Regenerative Medicine International Society-Americas and the Society For Biomaterials.

Biomaterials for Tissue Regeneration

ABSTRACT

Advances in biology, materials science, chemical engineering, and other fields have allowed for the development of tissue engineering, an interdisciplinary convergence science. For the past two and a half decades, our laboratory has focused on the development and characterization of biomaterials-based strategies for the regeneration of human tissues with the goal of improving healthcare outcomes. In a collaborative effort with physicians, surgeons, and other scientists, we have produced new material compositions and three-dimensional scaffolds, and investigated combinations of biomaterials with cell populations and bioactive agents for their ability to induce tissue formation and regeneration. We have examined the effects of material characteristics, such as mechanical properties, topographical features, and functional groups, on cell behavior and tissue guidance, and leveraged biomaterials as drug delivery vehicles to release growth factors and other signals with spatial and temporal specificity. This presentation will review recent examples of biomaterials-based approaches for regenerative medicine applications and highlight future areas of growth, such as the use of tissue engineering for validation of cancer therapeutic discovery.

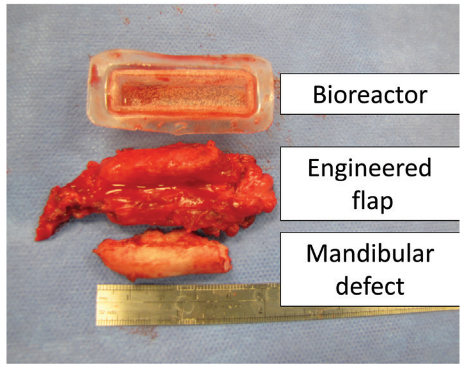

FIGURE: Mineralized free tissue flaps generated from in vivo bioreactors after nine weeks of implantation in the rib cage of sheep. These engineered flaps were appropriate for the reconstruction of large mandibular defects in the sheep model.

Nenand Bursac, Ph.D.

Professor of Biomedical Engineering, Duke University; Associate Professor in Medicine; Member of the Duke Cancer Institute; Co-Director of the Regeneration Next Initiative

nbursac@duke.edu

BIOGRAPHY

Nenad Bursac is a Professor of Biomedical Engineering, Medicine, and Cell Biology at Duke University. As a Ph.D. student in Robert Langer's group at MIT, he demonstrated the first engineering of functional heart tissues using mammalian cells. As a postdoctoral fellow in Leslie Tung's group at Johns Hopkins University, he developed novel methods to control architecture and function of cardiomyocyte cultures for studies of cardiac arrhythmias. Currently, Dr. Bursac's research involves development of novel cell, tissue, and genetic engineering therapies for heart and skeletal muscle disease. Examples of this work include engineering of first human contractile skeletal muscle tissues from primary and induced pluripotent stem cells, first fabrication of human cardiac tissue patches with clinically relevant dimensions, and use of engineered prokaryotic sodium channels as a platform for control of tissue excitability. Dr. Bursac has authored more than 90 scientific articles and has mentored more than 30 Ph.D. students and postdoctoral and medical fellows. He co-directs Regeneration Next Initiative at Duke University. He is a recipient of the Stansell Family Distinguished Research Award and Stem Cell Innovation Award. In 2014, Dr. Bursac was the president of the North Carolina Tissue Engineering and Regenerative Medicine Society. Since 2015, Dr. Bursac has been a Fellow of American Institute for Medical and Biological Engineering.

Modeling Muscle Physiology, Disease, and Regeneration

ABSTRACT

Engineering three-dimensional skeletal muscle tissues is motivated by the need for improved physiological systems that would serve for modelling and studying of muscle diseases, pre-clinical drug development, and potential muscle regenerative therapies. In this talk, I will describe first-time engineering of contractile human engineered muscle tissues made of primary myogenic cells derived from muscle biopsies and myogenic progenitors derived from induced pluripotent stem cells by transient overexpression of satellite cell marker Pax7. Resulting engineered microtissues ("myobundles") exhibit aligned architecture, multinucleated and striated myofibers, and a Pax7+ cell pool. They contract spontaneously and respond to electrical stimuli with robust calcium transients, twitch and tetanic contractions. During culture, myobundles maintain functional acetylcholine receptors and structurally and functionally mature, as evidenced by increased myofiber diameter, improved calcium handling and contractile strength, and enhanced expression of maturation genes. In response to diversely acting drugs, myobundles undergo dose-dependent hypertrophy or toxic myopathy similar to clinical outcomes. When derived using cells from patients with congenital skeletal muscle disease, myobundles exhibit expected pathological phenotype. When implanted into immunocompromised mice for 3 weeks, the myobundles progressively vascularize and maintain functionality. I will further show that incorporation of immune system cells into the engineered myobundles enhances their regenerative potential and enables near-complete structural and functional repair after cardiotoxin injury *in vitro* and hypoxic injury *in vivo*. Overall, tissue-engineered myobundles provide an enabling platform for predictive drug and toxicology screening and development of novel therapeutics for degenerative muscle disorders.

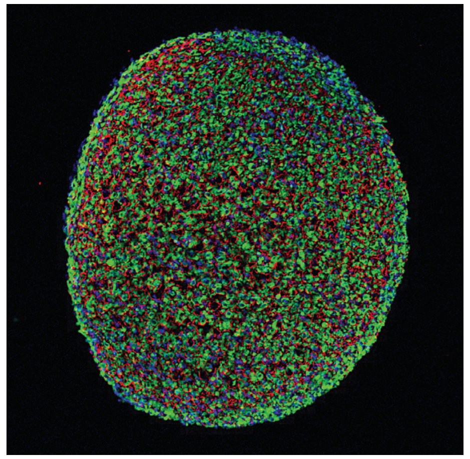

FIGURE: Cross-section of human tissue-engineered skeletal muscle in which green color labels protein actin within muscle fibers, red color labels extracellular matrix protein laminin, and blue color denotes cell nuclei.

Jian Yang, Ph.D.

Department of Biomedical Engineering, Pennsylvania State University;
Materials Research Institute, The Huck Institutes of The Life Sciences

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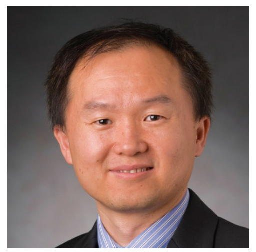

BIOGRAPHY

Dr. Yang received his Ph.D. in Polymer Chemistry and Physics in 2002 at Institute of Chemistry, The Chinese Academy of Science in Beijing. He is currently a full professor at the Department of Biomedical Engineering, The Pennsylvania State University. Dr. Yang has published 101 peer-reviewed journal articles, 9 issued patents, and 8 book chapters. He was a recipient of NSF CAREER Award (2010) and Outstanding Young Faculty Award of College of Engineering at UTA (2011). Dr. Yang was elected to the Fellow of American Institute of Medical and Biological Engineering (AIMBE) (Class of 2016). Dr. Yang serves as an Associate Editor for the journals "Bioactive Materials" and "Frontiers in Biomaterials" and also serves as a standing member for NIH "Biomaterials and Biointerfaces" study section. Dr. Yang is the founding secretary for (Oversea) Chinese Association for Biomaterials (CAB). He has co-founded a biotechnology company, Aleo BME, Inc. and is also serving on the medical advisory board for Acuitive Technologies, Inc.

Citrate Chemistry and Biology for Biomaterials Design and Applications

ABSTRACT

Leveraging the multifunctional nature of citrate in chemistry and inspired by its important biological roles in human tissues, a class of highly versatile and functional citrate-based biomaterials has been developed. Citric acid, historically known as an intermediate in the Krebs cycle, is a multifunctional, nontoxic, readily available, and inexpensive cornerstone monomer used in the design of citrate-based biomaterials. In addition to the convenient citrate chemistry for the syntheses of a number of versatile polymers that may be elastomeric or mechanically strong and tough, injectable and photocrosslinkable, and/or tissue adhesive, citric acid also presents inherent anti-bacterial, anti-clotting, angiogenic characteristics and modulates cellular energy levels leading to facilitated stem cell differentiation, which make citrate biomaterials ideal for a number of medical applications. Herein, a methodology for the design of multifunctional citrate biomaterials and their applications in regenerative engineering will be discussed.

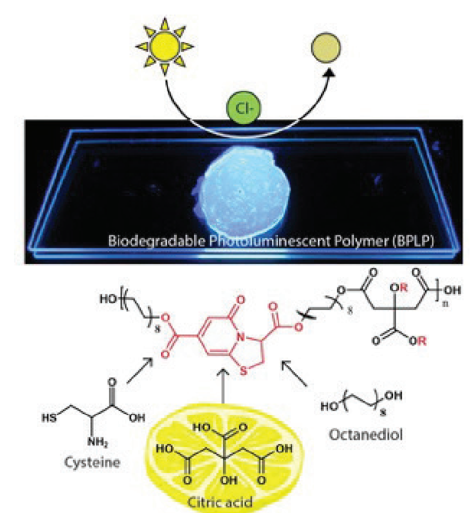

FIGURE: Biodegradable photoluminescent polymers developed for biosensing, bioimaging, and regenerative engineering.

Christine E. Schmidt, Ph.D.

J. Crayton Pruitt Family Endowed Chair, and Department Chair of the J. Crayton Pruitt Family Department of Biomedical Engineering, University of Florida

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BIOGRAPHY

Christine E. Schmidt is the J. Crayton Pruitt Family Endowed Chair and Department Chair of the J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida. Dr. Schmidt received her B.S. degree in Chemical Engineering from the University of Texas at Austin in 1988 and her Ph.D. in Chemical Engineering from The University of Illinois at Urbana-Champaign in 1995 (with D. Lauffenburger). She conducted postdoctoral research at MIT (with R. Langer) as an NIH Postdoctoral Fellow, joining the University of Texas at Austin Chemical Engineering faculty in 1996. She was one of the founding faculty members of the Department of Biomedical Engineering at UT Austin, and was at UT Austin until December 2012, when she moved to become the Chair of Biomedical Engineering at the University of Florida.

Dr. Schmidt is a Fellow of the American Institute for Medical and Biological Engineering (AIMBE), the American Association for the Advancement of Science (AAAS), the Biomedical Engineering Society (BMES), and a Fellow of Biomaterials Science and Engineering (FBSE) of the International Union of Societies of Biomaterials Science and Engineering. She is currently the President for AIMBE (2018-2020). She has also served previously as the Chair for the College of Fellows for AIMBE, as a member of the Board of Directors for BMES, and as the Conference Chair for the BMES annual meeting in 2010. She served as the inaugural Deputy Editor-in-Chief of the *Journal of Materials Chemistry B* from 2012 until 2016. She currently serves as the Neural Engineering Section Editor for *Current Opinion in Biomedical Engineering* and also currently serves on the Advisory/Editorial Boards for *Journal of Materials Chemistry B*, *Materials Horizons*, *Acta Biomaterialia*, *Journal of Biomedical Materials Research*, *Journal of Biomaterials Science*, *Polymer Edition*, and *Nanomedicine*. She has received numerous research, teaching, and advising awards, including the American Competitiveness and Innovation (ACI) Fellowship from NSF's Division of Materials Research, the Chairmen's Distinguished Life Sciences Award by the Christopher Columbus Fellowship Foundation and the U.S. Chamber of Commerce, the Women's Initiatives Committee's (WIC) Mentorship Excellence Award from AIChE, the Cockrell School of Engineering Distinguished Alumnus Award from The University of Texas at Austin, a National Science Foundation CAREER Award, and a Whitaker Young Investigator Award.

Dr. Schmidt is active in commercialization efforts. Her research on development of decellularized nerve tissue has been licensed and utilized in AxoGen Inc.'s Avance® nerve graft, which has impacted over 40,000 patients who suffer from peripheral nerve injuries. Her research is also the foundation for the start-up company, Alafair Biosciences, in Austin Texas that focuses on internal wound care management. Alafair's first clinical product, VersaWrap Tendon Protector was launched in December 2017.

Biomaterials for Nerve Repair Therapies

ABSTRACT

Damage to spinal cord and peripheral nerve tissue can have a devastating impact on the quality of life for individuals suffering from nerve injuries. Our research is focused on analyzing and designing biomaterials that can interface with neurons and specifically stimulate and guide nerves to regenerate. These biomaterials might be required for facial and hand reconstruction or in trauma cases, and potentially could be used to aid the regeneration of damaged spinal cord. Our research has focused on both top down and bottom up approaches to studying nerve regeneration and designing therapies ultimately for use in the clinic. In the top down approach, we have worked with modified nerve tissue to make it off-the-shelf accessible for nerve repair. To do this, our group has developed natural tissue scaffolds termed "acellular tissue grafts" created by chemical processing of normal intact nerve tissue. These grafts are created from natural biological (cadaver) tissue and are chemically processed so that they do not cause an immune response and are therefore not rejected in patients. These grafts have been optimized to maintain the natural architecture of the nerve pathways, and thus, are ideal for promoting the re-growth of damaged axons across lesions. These engineered, biological nerve grafts are currently used for peripheral nerve injuries and are being explored in intact and injectable formulations for spinal cord regeneration. In a parallel, bottom up approach, we have been developing biomaterials that have structure and chemical features that mimic nerve tissue. In particular, our research has focused on developing advanced hyaluronan-based scaffolds. Hyaluronic acid (HA) is a high molecular weight glycosaminoglycan found in all mammals and is a major component of the extracellular matrix in the nervous system. HA has been shown to play a significant role during embryonic development, extracellular matrix homeostasis, and, most importantly for our purposes, in wound healing and tissue regeneration. Our group is using magnetic microparticles that can be aligned and then dissolved to leave micron-scale channels inside HA hydrogels. We have found that these materials facilitate neuron interactions and are thus highly promising for regenerating nerves in vivo.

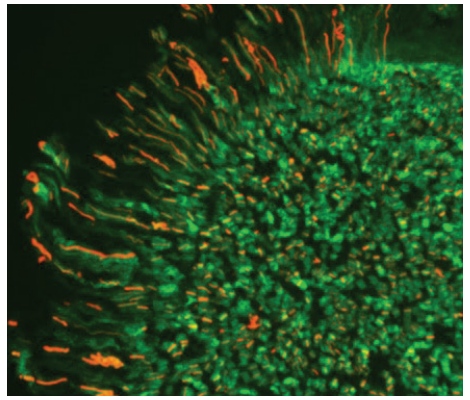

FIGURE: Peripheral nerve stained for neurofilament (red) and Schwann cells (green).

Cherie L. Stabler, Ph.D.

Associate Professor, Department of Biomedical Engineering, University of Florida; Affiliate member of the Diabetes Institute at the School of Medicine, University of Florida; Associate Chair of Graduate Students, Department of Biomedical Engineering, University of Florida

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BIOGRAPHY

Dr. Cherie Stabler is a tenured Associate Professor and Associate Chair of Graduate Studies in the Department of Biomedical Engineering, College of Engineering at the University of Florida. She also is an Affiliate Member of the Diabetes Institute at the School of Medicine at the University of Florida. She received her Ph.D. in Biomedical Engineering from The Georgia Institute of Technology & Emory University. Her research centers on the engineering of cell-based tissues for the treatment of Type 1 diabetes, specifically the development of novel biomaterials for: cellular encapsulation; three-dimensional scaffolds; and in situ oxygen and drug release. Through the fabrication of novel biomaterials capable of actively interfacing with the host, she seeks to modulate the graft environment to favor the survival and optimal function of the implanted cells. She has published in a broad range of journals, from the *Proceedings of the National Academy of Science*, to *Biomacromolecules*, to *Cell Transplantation*. She is an elected fellow of the American Institute for Medical and Biological Engineering and the recipient of the 2008 NIH NIDDK Type 1 Diabetes Pathfinder DP2 Award. Her research has been supported by the National Institutes of Health, the Juvenile Diabetes Research Foundation, and the Helmsley Trust.

Engineering Bioactive Material Platforms for Islet Transplantation

ABSTRACT

Clinical islet transplantation, the intrahepatic infusion of allogeneic islets, has the potential to provide physiological blood glucose control for insulin-dependent diabetics. The success of clinical islet transplantation, however, is hindered by the location of the implant site, which is prone to mechanical stresses, inflammatory responses, and exposure to high drug and toxin loads, as well as the strong inflammatory and immunological responses to the transplant in spite of systemic immunosuppression. To address these challenges, our research has focused on three primary strategies: the development of scaffolds to house islets at alternative transplant sites; the fabrication of encapsulation protocols for the immuno-camouflage of the transplant; and the production of bioactive biomaterials for the local delivery of oxygen and immunomodulatory drugs and/or cells. Three-dimensional scaffolds can serve to create a more favorable islet engraftment site, by ensuring optimal distribution of the transplanted cells, creating a desirable niche for the islets, and promoting vascularization. Encapsulation can substantially decrease the need for systemic immunosuppression of the recipient, by preventing host recognition of surface antigens. Finally, localization of supportive agents to the site of the transplant can serve to enhance efficacy, while minimizing the side effects commonly observed with systemic delivery. Success in these strategies should increase the efficacy of islet transplantation for the treatment of Type 1 Diabetes, whereby the long-term survival and engraftment of the transplanted islets are significantly improved.

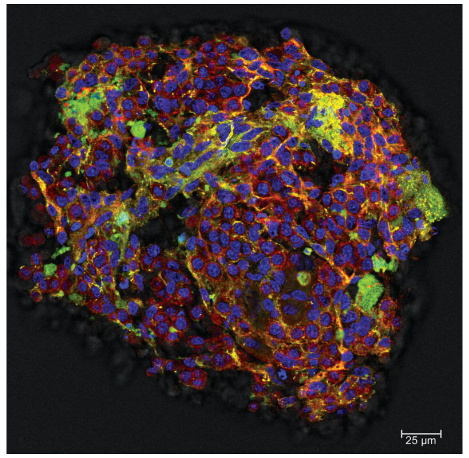

FIGURE: Whole mount immunohistochemistry staining of the extracellular matrix of a nonhuman primate islet.

Raphael Lee, MS (BmE), MD, ScD, DSc (hon)

Paul and Allene Russell Professor of Surgery (Plastic), Professor of Medicine (Dermatology), Professor of Organismal Biology and Anatomy, University of Chicago; Director, Center for Molecular Regeneration; Director, Chicago Electrical Trauma Rehabilitation Institute; Development Team Member, Center for Advanced Regenerative Engineering, McCormick School of Engineering, Northwestern University

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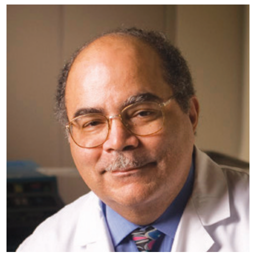


BIOGRAPHY

Dr. Lee, the Paul S. and Allene T. Russell Professor at the University of Chicago, is plastic surgeon and biomedical engineer. He holds appointments in Surgery, Medicine (Dermatology), Translational Medicine and Organismal Biology & Anatomy (Biomechanics). Dr. Lee's academic interests have focused on use of electrical and mechanical signals to regulate tissue healing and morphogenesis and characterized the biophysics of cell structural damage caused by physical forces and thermal trauma. This has led to in a now widely validated class of trauma therapeutics that preserves tissue viability following lethal injury. This research has been extended to develop agents that inhibit aggregation and catalyze refolding of denatured proteins. He has developed two surgical procedures for reconstruction of abdomen and perineal deformities.

Dr. Lee's research has resulted in new therapeutics which translated into establishment of three biotechnology companies. He chaired the University of Chicago president's advisory committee for technology transfer and commercialization. He is now promoting strategies recruiting support to establish technology companies in economically undeveloped communities. Dr. Lee now serves on the American College of Surgeon's Operation Giving Back Committee, a program to augment surgical training in developing nations.

Dr. Lee is a 1978 American College of Surgeons Schering Scholar, 1981 MacArthur Fellow and a 1985 Searle Scholar. Notable awards include the 1989 James Barrett Brown Award [American Association of Plastic Surgeons] for "Advancing Knowledge in the field of Plastic Surgery," the 1997 American Electrical Power Association Award for "Advancing Electrical Safety and Health" and the 2018 Pierre Galletti Award for "Fundamental Contributions Toward understanding the Molecular Biomechanics of Trauma." He was appointed a Senior Clinical Scholar of the Bucksbaum Institute (University of Chicago) in 2016. He has been elected to Fellowship in the Institute of Medicine (Chicago), Biomedical Engineering Society, American Institute for Medical and Biological Engineering, American Association of Plastic Surgeons, Institute for Electrical and Electronics Engineers, American Surgical Association, and American Association for the Advancement of Science. He is a member of the National Academy of Engineering (USA) and the International Academy of Medical and Biological Engineering. Dr. Lee has been named "distinguished alumnus" by three universities. Dr. Lee is consistently listed as a leading surgeon and physician by national and local organizations and publications.

Dr. Lee has served as President of: The Society for Physical Regulation in Biology and Medicine; the Drexel 100; The Quadrangle Club; Midwestern Association of Plastic Surgeons, and American Institute for Medical and Biological Engineering. He is a Trustee of Drexel University and serves on the board of several corporations. He has authored and co-authored more than 240 publications, co-edited 4 books and more than 18 primary patents.

Regenerative Engineering Approaches for Reconstructive Surgery

ABSTRACT

Traditional methods used in reconstructive surgery involves transferring tissue from one area of the body to the other to achieve better form and function for the patient. It can also involve transplantation of allogeneic organs or tissues to achieve that objective. The field of regenerative engineering offers additional options which have substantial advantages including isogeneic tissues and organs as well as less patient morbidity related to removal tissues from another part of the body. As regenerative engineering technology improves, it promises to become the primary mode for tissue reconstruction for congenital and acquired deformities.

This presentation will focus on clinical examples of tissue reconstruction using scaffolds, epigenetic biophysical regulation and autografted cells transplantation.

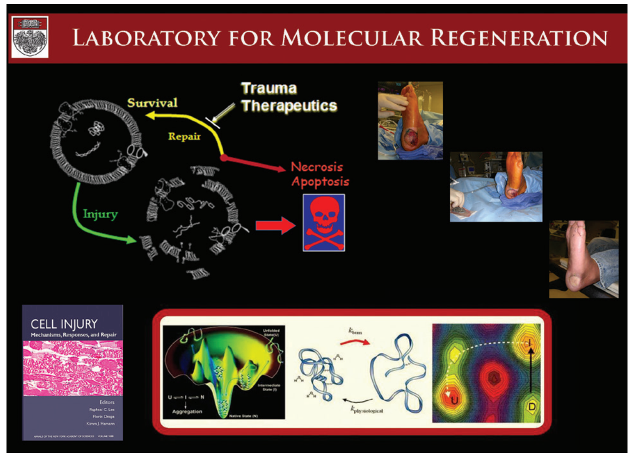


FIGURE: Regenerative engineering research and application has both laboratory and clinical aspects. The laboratory program focuses on development of synthetic molecular chaperones to augment cell recovery following physical trauma. The clinical component is focused on using application of mechanical stress to strengthen the healing of tissue scaffolds and with application of adipose derived stem cells in scaffolds for tissue regeneration.

Karen L. Christman, Ph.D., FAHA

Professor, Bioengineering, UC San Diego; Associate Dean, Jacobs School of Engineering, UC San Diego

christman@eng.ucsd.edu

BIOGRAPHY

Dr. Christman is a Professor in the Department of Bioengineering and the Associate Dean for Students in the Jacobs School of Engineering at UC San Diego. She received her B.S. in Biomedical Engineering from Northwestern University in 2000 and her Ph.D. from the University of California San Francisco and Berkeley Joint Bioengineering Graduate Group in 2003, where she examined *in situ* approaches to myocardial tissue engineering. She was also a NIH postdoctoral fellow at the University of California, Los Angeles in the fields of polymer chemistry and nanotechnology. Dr. Christman joined the Department of Bioengineering in 2007 and is a member of the Institute of Engineering in Medicine at the University of California, San Diego. Her lab, which is housed in the Sanford Consortium for Regenerative Medicine, focuses on developing novel biomaterials for tissue engineering and regenerative medicine applications, and has a strong translational focus with the main goal of developing minimally invasive therapies for cardiovascular disease. Dr. Christman is a fellow of the American Heart Association and the American Institute for Medical and Biological Engineering, and has received several awards including the NIH Director's New Innovator and Transformative Research Awards, the Wallace H. Coulter Foundation Early Career Translational Research Award, the American Heart Association Western States Innovative Sciences Award, and the Tissue Engineering and Regenerative Medicine Society's Young Investigator Award. Dr. Christman is also co-founder of Ventrix, Inc., which is in clinical trials with the cardiac extracellular matrix hydrogel technology developed in her lab at UC San Diego.

Injectable Biomaterials for Treating Cardiovascular Disease

ABSTRACT

Cardiovascular disease remains the leading cause of death in the western world. Two major types of cardiovascular disease, myocardial infarction and peripheral artery disease, have few available treatments and therefore numerous patients continue to decline towards heart failure for the former and amputation for the latter. Current clinical trials have focused on cell therapies, a mainstay of traditional regenerative medicine; however, it is thought that these cells act via paracrine mechanisms to recruit endogenous cells to help repair and regenerate the tissue. In animal models, it has been established that cellular recruitment to the damaged tissue can also occur via implantation of biomaterial scaffolds. Injectable materials as an approach for regenerative engineering are particularly attractive since they have the potential to be delivered minimally invasively, thereby requiring less recovery time and reducing the chances of infection. This talk will cover recent developments and translational progress with the use of injectable biomaterials for treating cardiovascular disease.

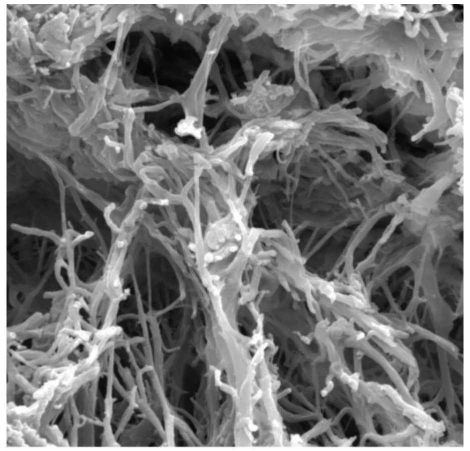


FIGURE: Nanofibrous architecture of injectable myocardial matrix hydrogel for treating myocardial infarction

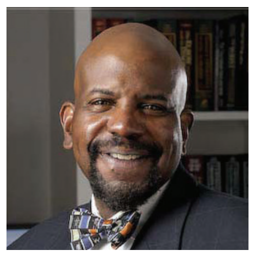
PANELISTS

Cato T. Laurencin, M.D., Ph.D.

University Professor, Albert and Wilda Van Dusen Distinguished Professor of Orthopaedic Surgery, Professor of Chemical and Biomolecular Engineering, Professor of Materials Science and Engineering, Professor of Biomedical Engineering

Director, The Raymond and Beverly Sackler Center for Biomedical, Biological, Physical and Engineering Sciences; Director, The Institute for Regenerative Engineering; Chief Executive Officer, Connecticut Institute for Clinical and Translational Science

The University of Connecticut



BIOGRAPHY

Cato T. Laurencin, M.D., Ph.D. is a University Professor at UCONN. He is the 8th designated in UCONN's history. He is Professor of Chemical Engineering, Professor of Materials Science and Engineering, Professor of Biomedical Engineering and the Albert and Wilda Van Dusen Distinguished Endowed Professor of Orthopaedic Surgery. He directs the Institute for Regenerative Engineering and the Raymond and Beverly Sackler Center at the University of Connecticut.

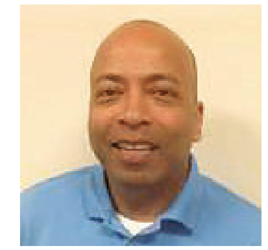
Dr. Laurencin is an expert in biomaterials, nanotechnology, stem cell science and the new field he has pioneered, Regenerative Engineering. He received his B.S.E. in Chemical Engineering from Princeton University, and his Ph.D. in Biochemical Engineering/Biotechnology from M.I.T where he was named a Hugh Hampton Young Fellow. Simultaneously, he received his M.D., Magna Cum Laude from the Harvard Medical School and received The James H. Robinson, M.D. Memorial Prize in Surgery.

Dr. Laurencin is an elected member of the National Academy of Engineering and the National Academy of Medicine. He is an elected fellow of the Indian National Academy of Engineering, the Indian National Academy of Sciences and the African Academy of Sciences. He is an Academician and member of the Chinese Academy of Engineering.

Dr. Laurencin received the Presidential Faculty Fellow Award from President Bill Clinton and the Presidential Award for Excellence in Science, Math and Engineering Mentoring from President Barack Obama. He is the recipient of the National Medal of Technology and Innovation, the United States' highest award for technological achievement, in ceremonies at the White House.

Debashish Chakravarthy, Ph.D.

VP Scientific Affairs Medline Skin and Woundcare Division, Medline Industries, Inc.



BIOGRAPHY

Dr. Chakravarthy is a technology specialist in the subject of wound/skin care and tissue regeneration. His educational and work background encompasses areas of chemical technology, chemistry, biochemistry and polymer science, subjects which are all integral to the now developed field of Biomaterials.

Dr. Chakravarthy has worked as a technology specialist in a range of companies, from small startups, to large multinationals. His most recent appointment is as the VP of Scientific Affairs at Medline Industries Inc. USA, which he joined in 2005. His duties there initially were to increase the breadth of the product line by innovating new product technologies, by scouting the globe and putting together viable manufacturing supply chains to allow commercialization of emergent technologies. Development of peer reviewed published evidence was integral to these activities.

Technology in the medical device field, particularly in the area of tissue regeneration, originates most often from adventurous small companies and/or Universities. Dr. Chakravarthy has played a critical role in this technology identification and adoption process proving that translational medicine in the field of biomaterials is not imaginary.

Richard T. Tran, Ph.D.

Manager, Polymer Development, Acuitive Technologies

BIOGRAPHY

Richard T. Tran is the Manager of Polymer Development at Acuitive Technologies. He holds a BSI in Bioinformatics from Baylor University and a Ph.D. in Biomedical Engineering from the University of Texas Southwestern Medical Center.

For the past 12 years, Richard's research efforts have been primarily focused on the design and characterization of citrate-based biomaterials with novel crosslinking, adhesive, antimicrobial, fluorescent, and chelating properties for cardiac, vascular, neural, gastrointestinal, and orthopedic regenerative engineering applications.

At Acuitive Technologies, Richard leads exploratory research teams to develop novel citrate-based formulations and characterize their biological performance for orthopedic applications. As a key member of the new product development team, he is engaged in design and manufacturing process development and as a technical expert in interactions with strategic partners and regulatory bodies.

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