SOCIETY FOR BIOMATERIALS

and

THE UNIVERSITY OF SOUTH DAKOTA'S

STUDENT CHAPTER OF

THE SOCIETY FOR BIOMATERIALS

Present:

Biomaterials Day 2015

Exploring Orthopaedic Biomaterials

UNIVERSITY OF

SOUTH DAKOTA

BIOMEDICAL ENGINEERING

THURSDAY, OCTOBER 1, 2015

SIOUX FALLS, SD

From the Biomaterials Day Committee



Dear Biomaterials Day Participants,

The University of South Dakota's Student Chapter of the Society for Biomaterials welcomes each of you to the 2015 Biomaterials Day. This year the theme of the conference is "Exploring Orthopaedic Biomaterials", and will focus on different aspects of the biomaterials used in orthopaedic applications.

On behalf of the chapter and organizers, we are excited to announce a terrific slate of speakers. The event's keynote speech, regarding chitosan characterization, will be given by Dr. Joel Bumgardner, Associate Editor of Journal of Biomedical Medical Materials Research Part B: Applied Biomaterials and past president of the Society for Biomaterials. Further, Dr. Johnna Temenoff from Georgia Institute of Technology and Dr. Tae-Hong Lim of the University of Iowa will be delivering their talks on different aspects of Orthopaedic Biomaterials. Moreover, we are looking forward to our panel discussion regarding the USD Discovery District, a research park, which that be a resource for biotech companies and start-ups in South Dakota and to serve to connect universities with innovation-driven businesses. We are confident that this year's speakers, panel discussion and exhibitions will make this event a huge success.

As one of only a select few universities in the country that host Biomaterials Day conferences, we hope our event provides a unique opportunity for both new and well-established members of the biomaterials and biomedical engineering fields to collaborate and network. Additionally, we hope that all participants feel engaged and are able to use this meeting as a platform for conversation and dialogue to continue to build professional relationships.

We would like to take this opportunity to sincerely thank everyone who has contributed towards making our 2015 Biomaterials Day possible. A lot of thanks to the Society for Biomaterials national organization for awarding our chapter with a grant to host this event. We would like to express our appreciation to our other sponsors: the University of South Dakota Biomedical Engineering Department and South Dakota Biotech Association for their generous contributions. Special thanks to those students who have volunteered their time to help out over the course of the conference. Last, but not the least, a very special thanks to our chapter advisor, Dr. Gopinath Mani, who guided us in planning, organizing and executing the event.

Thank you again for attending the 2015 Biomaterial's Day!

USD Society for Biomaterials Committee,

President, Niranjan Ghimire
Secretary and Treasurer, Eric Sandhurst
Bylaws and Social Chair, Yangxi Liu

Sponsors

Society For Biomaterials

Mission: The Society For Biomaterials is a multidisciplinary society of academic, healthcare, governmental and business professionals dedicated to promoting advancements in all aspects of biomaterial science, education and professional standards to enhance human health and quality of life.

Vision: The Vision of the Society for Biomaterials is to serve as the world's preeminent interactive global community committed to advancing excellence in all aspects of biomaterial science, engineering and technology for promoting human health and well-being.

UNIVERSITY OF SOUTH DAKOTA

Our Mission: The University of South Dakota offers undergraduate, graduate and professional programs within the South Dakota System of Higher Education. As the oldest university in the state, the University of South Dakota serves as the flagship and the only public liberal arts university in the state.

Our Vision: To be the best small, public flagship university in the nation built upon a liberal arts foundation.

Our Values: The University of South Dakota is committed to becoming a regional leader in diversity and inclusiveness initiatives and the practice of Inclusive Excellence.

south dakota biotech

Connect. Collaborate. Innovate.

South Dakota Biotech is the state affiliate of the Biotechnology Industry Organization (BIO). This non-profit organization is dedicated to developing biotechnology through expanding research, advocacy, funding, education, infrastructure development and promotion.

Formed in 2006, South Dakota Biotech serves a membership which includes business, universities, service providers and state-wide economic development entities to expand the bioscience industry. The primary goals of the association are to: connect leaders and experts, collaborate to shape the future, drive innovation to feed, fuel, and heal the world.

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University of South Dakota
Biomedical Engineering Department

Biomedical engineering (BME) focuses on the application of engineering and science methodologies to the analysis of biological and physiological problems and to the development and delivery of emerging health care technologies.

The biomedical engineer serves as an interface between traditional engineering disciplines and living systems and may work in either direction, applying the patterns of living organisms to engineering design or engineering new approaches to human health. Both the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees are cross-disciplinary degrees. The objective of the M.S. program is to prepare a student for research and development careers in biomedical industry and for additional training at the doctoral level. The Ph.D. program will prepare a student for a career as a researcher who advances the frontiers of biomedical science and engineering with attention to generating new ideas for commercialization.

Dr. Daniel Engebretson
Chair of the BME Program

Dr. Erin Harmon
Lab Manager

Jill Pick
Program Assistant

Dr. Ying Deng
Associate Professor

Dr. Gopinath Mani
Assistant Professor
SFB Faculty Advisor

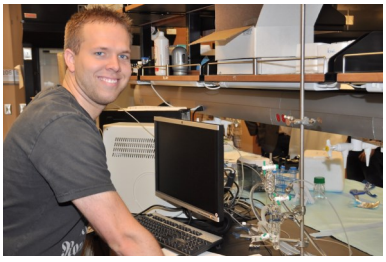
Dr. Hongli Sun
Assistant Professor

Dr. Carol Lushbough
Assistant Professor

Dr. Zhongkui Hong
Assistant Professor

Dr. Yu Huang
Assistant Professor

University of South Dakota
Biomedical Engineering Department



The University of South Dakota's Biomedical Engineering Department is based in Sioux Falls at the Graduate Education and Applied Research Center (GEAR Center), 4800 N. Career Ave., Suite 221, Sioux Falls, SD 57107.

The South Dakota Public University and Research Center (University Center) is a collaboration of the South Dakota Board of Regents and all of the regental universities in the state. The GEAR Center was opened in Spring, 2009 in Sioux Falls to stimulate applied research and commercialization in South Dakota. The U's Biomedical Engineering program and Center for Research & Development of Light-activated Materials are both housed in the GEAR CENTER.

Vision

The GEAR Center is a collaborative environment where innovative solutions are sought to relevant problems and where entrepreneurism is encouraged.

Focus

The cohesive research focus of the GEAR Center creates a critical mass of expertise and resources, and is aligned with state priorities in biomedical and material sciences and biotechnology.

Shifting South Dakota Technologies into High GEAR

- Encouraging collaborations between researchers at regional universities; other universities and colleges; government agencies; small businesses; and industries with related interests
- Developing technologies which enable biomedical/biological devices, materials, processes, and services
- Providing educational and research opportunities for graduate and post-graduate students
- Training the next wave of the state's high technology workforce

AGENDA

Time	Session	Speaker
8:00 – 8:50 am	Registration, Breakfast and Poster Setup	
8:50 – 9:00 am	Welcome & Opening Remarks	Dr. Dan Engebretson, University of South Dakota
9:00 – 10:00 am	Plenary Speaker 1	Dr. Johnna S. Temenoff, Georgia Institute of Technology ***"GAG-based Biomaterials for Orthopaedic Applications"***
10:00 – 10:15 am	Coffee Break/ Network/ Poster Exhibition	
10:15 – 11:15 am	Plenary Speaker 2	Dr. Tae-Hong Lim, University of Iowa ***"Normal Biomechanical Loads in the Lumbar Spine"***
11:15 – 12:15 pm	Poster Presentations/ Poster Exhibition	
12:15 – 1:15 pm	Lunch	
1:15 – 2:30 pm	Keynote Speaker	Dr. Joel D. Bumgardner, University of Memphis ***"Not all Chitosans are Created Equal: Characterization Matter"***
2:30 – 3:00 pm	South Dakota Biotech Association	Joni Johnson
3:00 – 3:15 pm	Coffee Break/ Poster Exhibition	
3:15 – 4:00 pm	Panel Discussion	Rich Naser Dr. Dan Engebretson Joni Johnson
4:00 – 4:30 pm	Commencement, Reception & Awards	

KEYNOTE SPEAKER

Not All Chitosans are Created Equal: Characterization Matters

JOEL D. BUMGARDNER, PHD

PROFESSOR,

DEPARTMENT OF BIOMEDICAL ENGINEERING,

THE UNIVERSITY OF MEMPHIS

Dr. Joel D. Bumgardner is a biomaterials researcher with extensive experience and expertise in developing dental and orthopaedic alloys, as well as expanding the depth of our knowledge on corrosion, surface coatings, bone tissue engineering, drug delivery and biocompatibility. His research has provided key insights into material – cell interactions and biocorrosion processes that have advanced our understanding of dental and implant alloys. He also is a leader in investigating and developing the biopolymer, chitosan, for use in implant coatings, drug delivery and tissue engineering applications. He has over 88 journal articles, 17 book chapters, 6 patent disclosures (2 licensed for infection abatement therapies using chitosan materials) and 215+ presentations and invited lectures. More importantly, he has mentored over 60 students; 9 of which have received NSF or Whitaker graduate fellowships, 4 Fulbright Fellowships, and more than 15 students accepted to medical, dental or law school. He has received numerous awards for his research and instruction including the 2012 Outstanding Instructor Award in the Herff College of Engineering at the University of Memphis. He also received Outstanding Professor (2001 & 2002) Awards in the Bagley College of Engineering, Mississippi State University, and the University of Alabama Engineering School Alumni recognition award as one of the '40 Engineers Making a Difference' in 2011. He was an elected Fellow (2011) of American Institute of Medical & Biological Engineering and a JW Fulbright Scholar (1994), Umeå University, Umeå Sweden. He is active in several professional organizations such as American Association for Dental Research, American Institute of Medical & Biological Engineering and the Society for Biomaterials, in which he has held numerous leadership positions including program chair of the 2005 Annual Meeting, and President (2012-2013). He is a regular reviewer for the NIH and NSF and many biomaterials related journals and serves as an Associate Editor of the Journal of Biomaterial Materials Research: Part B. He obtained his BS Degree in Biology from Florida State University, and his BS in Materials Science, and MS and PhD in Biomedical Engineering all from the University of Alabama at Birmingham. Dr. Bumgardner was a faculty member in the Department of Agricultural and Biological Engineering at Mississippi State University (1994-2004) and is currently a professor and co-Academic programs Director in the Biomedical Engineering Department at the University of Memphis (2004-present).

Abstract: Not All Chitosans are Created Equal: Characterization Matters

Chitosan is derived from chitin, the second most abundant polysaccharide after cellulose on the planet. With the development of the seafood processing industry, efforts to find solutions to the accumulating shellfish wastes began in earnest in the mid-20th century, and have spread world-wide in areas including water treatment, agriculture, textiles, food/health supplements, cosmetics and biomedical and related technologies. Biomedical and related technologies have been identified as one of the largest and most profitable uses of chitin and chitosan materials. The general biocompatibility of chitin and chitosan polysaccharides is largely attributed to their chemical/structural homology with many native proteoglycans and extracellular matrix components. Because of these properties, chitin and chitosan-based materials have been widely researched for use as implant coatings, tissue engineering/regenerative medicine constructs, and drug delivery vehicles. This presentation will provide an overview of chitin/chitosan materials and their use in biomedical applications with emphasis on use of chitosan coating, fibers, sponges and beads in dental/craniofacial and orthopedic applications as well as highlighting challenges for these polysaccharides to achieve their potential in solving medical problems and meeting the needs in the biomaterials industry.

PLENARY SPEAKERS

GAG-based Biomaterials for Orthopaedic Applications

JOHNNA S. TEMENOFF, PHD

PROFESSOR,
WALLACE H. COULTER DEPT. OF BIOMEDICAL ENGINEERING,
GEORGIA INSTITUTE OF TECHNOLOGY AND EMORY UNIVERSITY
PETIT FACULTY FELLOW
CO-DIRECTOR,
REGENERATIVE ENGINEERING AND MEDICINE CENTER

Dr. Johnna Temenoff completed her Ph.D. and post-doctoral fellowship at Rice University in tissue engineering and orthopaedic biomaterials. In 2005, she joined the faculty in Biomedical Engineering at Georgia Tech/Emory University. Over the course of her career to date, Dr. Temenoff has published over 40 peer-reviewed papers, 10 book chapters, and produced over 90 scientific abstracts for national and international conferences. Dr. Temenoff has received funding from an impressive range of sources, including federal agencies (NIH and NSF) and groups such as the Aircast Foundation and National Football League Charities, and currently serves at the Principle Investigator on a NIH T32 Predoctoral Training grant in biomaterials. She has been honored with several prestigious awards, such as the NSF CAREER Award and the Arthritis Foundation Investigator Award, and was recently named to the College of Fellows of the American Institute for Medical and Biological Engineers (AIMBE). She also acts as the Co-Director for the Regenerative Engineering and Medicine Center, a statewide initiative encompassing three premier research universities in Georgia (Georgia Tech, Emory University, and the University of Georgia).

Dr. Temenoff has demonstrated her commitment to undergraduate biomaterials education by co-authoring a highly successful introductory textbook - Biomaterials: The Intersection of Biology and Materials Science, by J.S. Temenoff and A.G. Mikos. This book has been adopted in over 50 universities, including several top-tier biomedical engineering departments in the U.S. In addition, it has also been printed in three international editions. In response, Dr. Temenoff and Dr. Mikos were awarded the American Society for Engineering Education's 2010 Meriam/Wiley Distinguished Author Award for best new engineering textbook. Dr. Temenoff has also served on the editorial board for the journals *Scientific Reports, Tissue Engineering, Journal of Biomedical Materials Research: Part A, and Journal of Materials Chemistry B*, and as a member of the advisory council for the Tissue Engineering and Regenerative Medicine International Society-NA (TERMIS-NA) as well as several roles in the Society for Biomaterials.

Abstract: GAG-based Biomaterials for Protein Delivery and Stem Cell Differentiation

We have recently developed a family of glycosaminoglycan (GAG)-based biomaterials with varying levels of affinity to positively-charged proteins. This presentation will highlight the versatility of these materials to modulate cellular response to soluble cues. Our in vitro results suggest that material sulfation level affects progenitor cell differentiation towards a chondrocytic phenotype, and that this may be exploited in controlled ways to direct differentiation of stem cells both before and after implantation to achieve maximal healing of orthopaedic defects. Moreover, strong affinity interactions may be used to sequester endogenous signals and therefore better control timing of cellular differentiation. This presentation will also summarize the development of these materials as in vivo protein delivery vehicles, including how GAG sulfation pattern promotes tunability of release kinetics for a wide range of injury types.

PLENARY SPEAKERS

Normal Biomechanical Loads in the Lumbar Spine

TAE-HONG LIM, PHD

PROFESSOR,
DEPARTMENT OF BIOMEDICAL ENGINEERING,
THE UNIVERSITY OF IOWA

Dr. Tae-Hong Lim is a renowned biomaterials engineer who has performed some of his most celebrated work in the field of biomechanics. His research combines drug delivery, biomaterials and other key aspects of the mechanical and biomedical fields. Dr. Tae-Hong Lim is currently a Reviewer for *The Journal of Biomedical Engineering*, *Journal of Biomechanics* and *Journal of Orthopaedic Research*. He is also the Advisory Editor for *Spine* and the Associate Editor for *The Spine Journal*. He obtained his BS and MS Degrees in Mechanical Design and Production Engineering from Seoul National University, in Seoul, Korea. Dr. Lim went on to earn his PhD in Mechanical Engineering from the University of Iowa. Earlier in his career, among other positions, he was an Associate Professor & Director of Biomechanics Laboratory in the Department of Orthopaedic Surgery at the Medical College of Wisconsin in Milwaukee, WI. Later, he became an Associate Professor at the Department of Orthopaedic Surgery at Rush University and Rush-Presbyterian-St. Luke's Medical Center in Chicago, IL. In addition to his position at Rush, Dr. Lim was an Adjunct Associate Professor in the Department of Bioengineering at the University of Illinois at Chicago, Chicago, IL. Dr. Tae-Hong Lim is currently a Professor in the Department of Biomedical Engineering at the University of Iowa in Iowa City, IA. Dr. Lim demonstrates a strong dedication and commitment to academia and research and has been awarded with funding from a wide range of institutions, including federal agencies and private organizations such as NSpine, Inc., Howmedica Osteonics Corp., and Cervical Spine Research Society. Over the course of his career to date, Dr. Lim has published over 90 journal publications with over 3,000 citations and holds three US patents with the most recent patent being issued in January of 2015 in Korea, Australia, and US. His current research interests on biomechanical issues include spine biomechanics, effect of mechanical loads on the cellular activities in the intervertebral discs, Discogenic Low Back Pain, and mathematical modeling of spinal muscles.

Abstract: Normal Biomechanical Loads in the Lumbar Spine

Low back pain (LBP) is one of the most significant ailments affecting the quality of life. It is generally agreed that LBP results from the combined effect of inflammation and abnormal biomechanics caused from disc degeneration. However, our understandings of the pathology, mechanism, and consequence of disc degeneration remain still primitive and no ideal treatment method has been found yet despite of the introduction of numerous clinical options. Furthermore, there has been little investigation of the roles of back muscles in governing the spinal biomechanical environment although it may be the most crucial factor in controlling the normal function of the spine. Results of our analytical studies show that the spinal muscles are able to produce the pure compressive load in the lumbar spine (follower load) while the direction of these compressive loads follows the spinal curvature. Finite element analyses confirmed that the lumbar spine subjected to the spinal muscle forces producing such follower compressive loads can be in a stable condition regardless of its posture. Our in-vivo study results also demonstrate that the application of shear force whose direction is transverse to the spinal curvature induces the early disc degeneration and pain behavior in rats. These results indicate that the normal biomechanical load in the spine would be a pure compressive load whose direction follows the spinal curvature (follower compressive loads). If so, the understanding of spinal muscle contraction patterns creating the follower compressive loads would be crucial for the development of better methods of prevention and treatment of various spinal disorders. These findings and postulations led us to invent an innovative non-surgical method for treating LBP. The underlying rationale is that most LBP patients can be treated with the proper strengthening of back muscles. However, patients cannot have normal activities and muscle strengthening exercises due to LBP. Thus, we have developed a new temperature responsive hydrogel and biodegradable microspheres which can deliver the pain relieving agent into the painful disc through percutaneous injection and release it in a controlled manner for active pain control for about 6 months. Also suggested is a new clinical paradigm for better diagnosis and treatment of discogenic LBP using our new drug delivery system.

Panel Speakers

Rich Naser

President,

University of South Dakota Research Park

Joni Johnson

Executive Director,

SD Biotech Association

Dr. Daniel Engebretson

Department Chair, Biomedical Engineering,

University of South Dakota

Ex-Officio Member, USD Discovery District

Poster Session

1. Mariah M. Hoffman, Dmitri S. Kilin, Andrew G. Sykes; **Photophysical and Chemical Processes Controlling the Emission Spectra of Rhodamine-Anthraquinone Sensors**
2. Hanna Sanyour, Yann Estornes, Mathieu Bertrand; **Validation of hits identified in an siRNA screen as positive regulators of ER stress-induced death**
3. Jacob Miszuk, Tao Xu, Hao Fong, Hongli Sun; **Novel 3D Electrospun Nanofibrous Scaffold for Bone Tissue Engineering**
4. Diego Velasquez Pulgarin, Cheyenne S. Rhodes, Hengjie Su, Warren O. Haggard, Joel D. Bumgardner; **Fatty Acid Treated Electrospun Chitosan Nanofiber Membranes Reduce LPS-induced Macrophage Activation**
5. Yangxi Liu, Hongli Sun; **Anti-Inflammatory Effects of Erythropoietin-based Drug on Macrophages**
6. Eric Sandhurst, Hongli Sun; **Bioinspired Modulation of Stem Cells Through Development of Biodegradable Porous Microspheres for Tissue Regeneration**
7. Jordan Kuiper, Sujan Lamichhane, Gopinath Mani; **Release of Nitric Oxide from Helparin Coated Cobalt-Chromium (Co-Cr) Surfaces**
8. Lindsey L. Marshall, Therese M. Downey; **Purification of a Novel Drug Substance Using Preparative HPLC**

Judges

***Dr. Tyler Remund* — Director - Vascular Research Commercialization at Sanford Research**

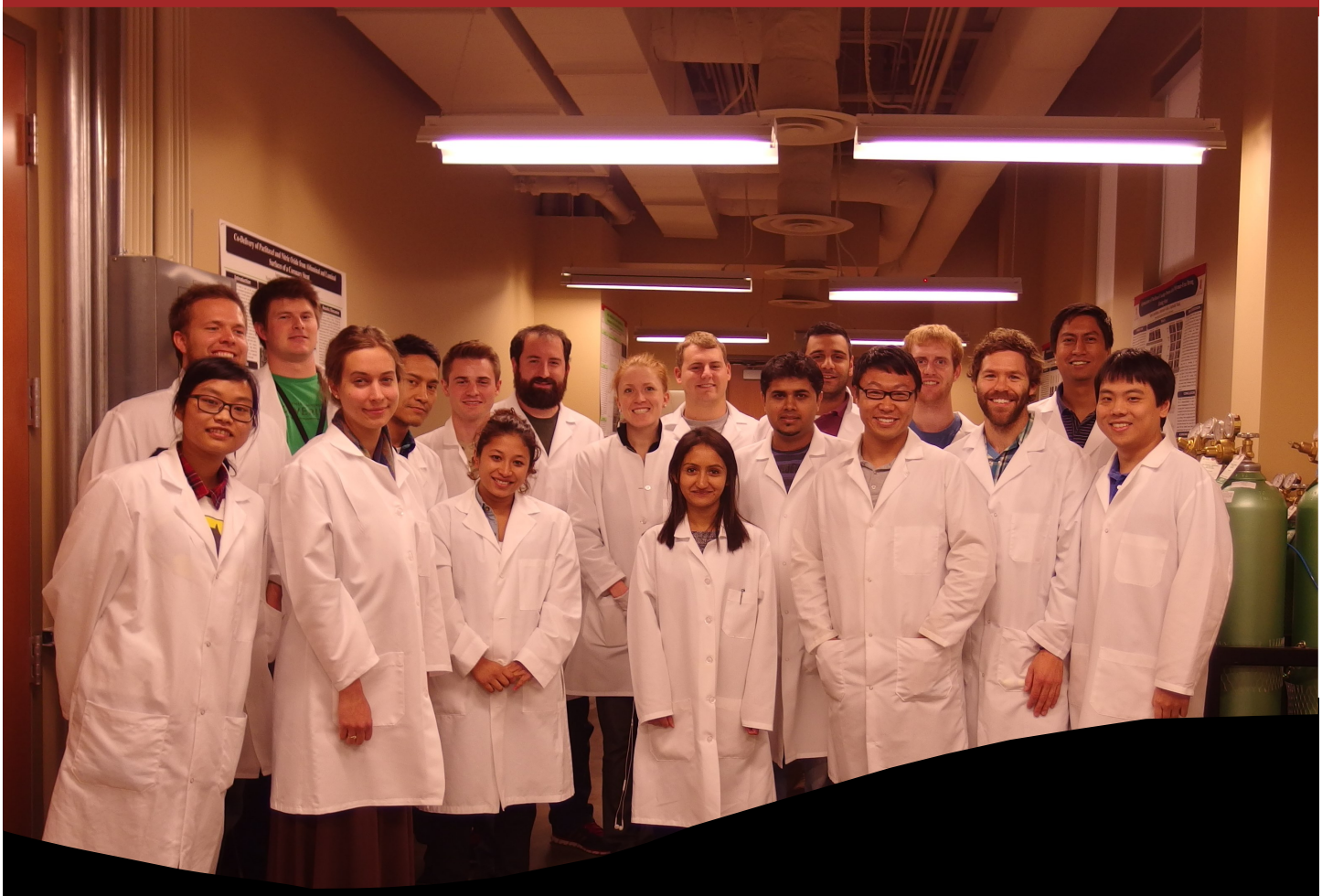
***Dr. Yu Huang* — Assistant Professor, Biomedical Engineering, University of South Dakota**

***Dr. Tony Slieman* — Assistant Professor, Basic Biomedical Sciences, University of South Dakota**

EXHIBITION POSTERS

1. Erin B. Harmon and Daniel Engebretson; **BioSNTR Resources at the Graduate Education and Applied Research (GEAR) Center**
2. Hongli Sun; **Bioinspired Bone Tissue Engineering & Regenerative Medicine**
3. Qingqing Yao; **Multifunctional Chitosan-45S5 Bioactive Glass-Poly(3-hydroxybutyrate-*co*-3-hydroxyvalerate) Microsphere Composite Membranes for Guided Tissue/Bone Regeneration**
4. Yangxi Liu, Andre A. Williams, and Joshua A. Orlicki; **Detection of Early Onset of Metal Corrosions**
5. Berit Foss, Thomas Maxwell, and Ying Deng; **Chondroitin Sulfate and Glucosamine Promote the Mechanical Properties of Alginate Hydrogel for Nucleus Pulposus Tissue Engineering**
6. Bo Yang, Ying Deng; **A Berberine-Loaded Electrospun PCL Nanofibrous Membrane as a New Wound Dressing Material**
7. Niranjan Ghimire; **Osseo-integration and Biofilm Formation on Different Ti-Surfaces in a Post-operative Infection Model**
8. Wei Lv, Jie Luo and Yuyu Sun; **Chitosan-immobilized Polymer Surfaces for Rechargeable Antimicrobial Drug Binding and Releasing**
9. Jessica Vlcek, Sarah Jones-Sapienza, Ying Deng; **Poly (Glycerol Sebacate) (PGS) as a Biocompatible Scaffold Material for Esophageal Tissue Engineering**
10. Niranjan Ghimire, Jie L., Sun Y., Deng Y; **Enhanced Osteogenic Properties of Chitosan Functionalized Titanium for Orthopedics Use**
11. Susan Stoebner, Gopinath Mani; **Drug Delivery from Microrough Cobalt-Chromium Alloy Surfaces for Cardiovascular Stent Applications**
12. Annemarie Gallo, Gopinath Mani; **Co-Delivery of Paclitaxel and Nitric Oxide from Abluminal and Luminal Surfaces of a Coronary Stent**
13. Sujan Lamichhane, Annemarie Gallo, Gopinath Mani; **Optimization of Paclitaxel Coating Process for a Polymer-Free Drug-Eluting Stent**
14. Sujan Lamichhane, Tyler Remund, Mark Larson, Patrick Kelly, Gopinath Mani; **Albumin and Fibrinogen Adsorption, Platelet Adhesion and Activation on ePTFE and Electrospun PTFE**
15. Eagappanath Thiruppathi, Mark Larson, Gopinath Mani; **Surface Modification of CoCr alloy Using Phosphoric and Phosphonoacetic Acids: Protein and Platelet Interactions**
16. Eagappanath Thiruppathi, Gopinath Mani; **Vitamin-C incorporated Poly-(lactic-co-glycolic acid) Platform for Cardiovascular Stents**
17. Sujan Lamichhane, Susan Lancaster, Eagappanath Thiruppathi, Gopinath Mani; **Interaction of Endothelial and Smooth Muscle Cells with Paclitaxel-Immobilized Self Assembled Monolayers**
18. Yu Huang; **Micro-engineered Materials for *In Vitro* Study of the Brain and Beyond -- An Overview of Brain μ-Engineering Lab Research**

Thank you for attending the University of South Dakota's 2015 Biomaterials Day



Society For Biomaterials

UNIVERSITY OF SOUTH DAKOTA

The University of South Dakota's Student Chapter of the Society for Biomaterials