

**LETTER FROM OUR NEW PRESIDENT
UPDATES FROM THE TE AND EDUCATION SIGS**

BIOMATERIALS FORUM



OFFICIAL NEWSLETTER OF THE SOCIETY FOR BIOMATERIALS

Second Quarter 2017 • Volume 39, Issue 2

ALSO INSIDE

**CALL FOR 2018 AWARD AND
OFFICER NOMINATIONS**

**HIGHLIGHTS ON INTERNATIONAL
BIOMATERIALS SYMPOSIUM –
CHINA AT CLEMSON**

BIOMATERIALS FORUM!

The official news magazine of the **SOCIETY FOR BIOMATERIALS** • Volume 39, Issue 2

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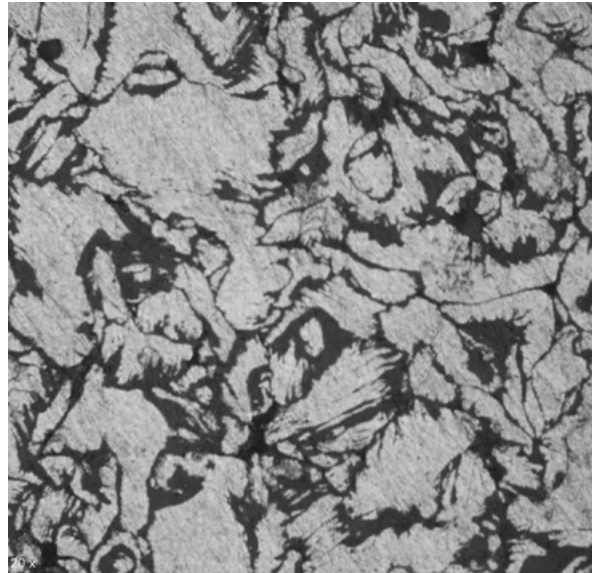
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On the cover: The cover image, provided by graduate student Haripriya Ramesh from North Carolina State University, is an optical micrograph taken in collaboration with the Indian Institute of Technology Madras and Anna University in Chennai, India. It shows that the Mg-HA composite comprising wet milled particles in ethanol exhibits a uniform distribution of the apatite particles and well-dispersed smaller grains broken down by shear forces. The sample was etched in 2g of picric acid mixed with 50ml of ethanol.

TECHNOLOGY ALONE IS NOT ENOUGH

Guigen Zhang

To echo Steve Jobs' argument that "It is in Apple's DNA that technology alone is not enough — it is technology married with liberal arts, married with the humanities, that yields us the result that makes our heart sing," I included some of my arguments on this subject in my textbook recently

published by the CRC Press (see more in the Members in the News section).

In a 1989 article (*Issue in Science and Technology*, 82–88) titled "The Civilized Engineer," Samuel Florman summarized his views with many historical, and anecdotal, accounts in arguing for the need to broaden the horizons of engineering education to include liberal arts and humanities content. According to Florman, back in the early 1860s, General Sylvanus Thayer (1785–1872), known as the father of the U.S. Military Academy at West Point, endowed an engineering school at Dartmouth College where he advocated the training of engineers in engineering subjects — science and mathematics — and liberal arts. However, General Thayer's idea never gained much traction on a larger scale because the passing of the Morrill Act, the so-called "land grants," by the U.S. Congress in 1862 tilted engineering education in America toward the training of the industrial classes. And it has pretty much stayed that way ever since, even though calls for adding more liberal arts and humanities content to engineering education have never faded.

Engineering is about creating what has never been and turning opportunities into means for the sustainable advancement of the human race and our civilized society. A wrongly defined problem, even solved correctly in a technical sense, may lead to unintended consequences. Thus, to be able to define the problems rightly in a societal-relevant context, engineers should be not only technically competent but also fully conscious of the humanistic and economic context surrounding these technical challenges, because all engineering problems are technical challenges rooted in a socially, economically, environmentally and humanistically intertwined world. General George Marshall once complained that he did not receive a good education at the Virginia Military Institute because there was no training in history. He knew that to be a leader, one must have a sense of history, for history is the human story. The same can be

said for an engineer: To be able to innovate, the engineer must have a sense of humanistic appreciation of our society, for innovation is not just a technical endeavor, but a human one, as exemplified by "Apple's DNA" in Steve Jobs' words.

It is good to see the general trend of integrating arts to the science, technology, engineering and math (STEM) education — transforming from STEM to STEAM. To me, the arts we talk about here should be the liberal arts, allowing future engineers to become technically competent and also conscious of social needs so they can innovate not just for the technological pursuit, but also for an endeavor to create technology for humanity.

In closing, let me briefly mention what we have prepared for you in this issue. In From the President, our new president David Kohn shares with us a recap of the 2017 Annual Meeting with a list of SFB student awards winners, including winners of the educational module for middle schoolers development competition and the business plan competition, as well as his vision for SFB in the coming year. In the News & Updates section, you will find member news prepared by our new member-at-large, Helen Lu; a staff update from Deb Dupnik; and a Student Chapter update from our new Student Chapter president, Daniel Hachim. In the Special Interest Group (SIG) section, we have updates from the Tissue Engineering SIG and the Education SIG. In our regular columns, you will find latest industry news from Steve Lin, educational news from Yusuf Khan and a book review from Immediate Past President Liisa Kuhn as a guest book review editor. Finally, I want to bring your attention to the Call for 2018 Awards and Officer Nomination and the Call for nominations for Student/Trainee Awards, as well as some highlights from the 2017 China-themed International Biomaterials Symposium held at Clemson.

Best wishes,

Guigen Zhang | Executive Editor, Biomaterials Forum

The Student Travel Achievement Recognitions (STARs) recognize research excellence and develop future leaders within our Society. The STAR recipients are selected according to the following procedures:

SIG officers will review a list of the SIG Student Recognition applicants who applied for the STAR Awards when submitting their meeting abstracts, along with their abstract titles and scores. Each SIG will then nominate

several students to the Society's Education and Professional Development Committee for consideration. The Educational and Professional Development Committee will then review the nominations and select the STAR recipients who each receive a monetary award of \$250. Those abstracts recommended by the SIGs, but not selected by the Educational and Professional Development Committee will receive honorable mentions.

2017 Student Travel Award (STAR) Recipients

Alexis Trent
Virginia Polytechnic Institute
and State University

John Barrett
University of Chicago

Sergio Montelongo
University of Texas at San Antonio

Stanley Chu
University of Colorado Boulder

Maria Coronel
University of Florida

Deepak Gupta
Indian Institute of Technology Bombay

Stuart Young
Queen's University

Vimala Bharadwaj
Arizona State University

Leo Wang
University of Pennsylvania

Jordan Anderson
University of South Dakota

Jomy Varghese
University of Rochester

Pavan Sandhu
University of Texas at Dallas

Joseph Vanderburgh
Vanderbilt University

Mousa Younesi
Case Western Reserve University

Alex Dang
Columbia University

Joshua Stewart
University of Florida

Alberto Purwada
Cornell University

Devon Headen
Georgia Institute of Technology

Tracie McGinnity
University of Notre Dame

Sichang Lu
Vanderbilt University

Maxime-Alexandre Ferko
University of Ottawa

Fangqi Gu
Duke University

Misaki Komeda
Osaka University

Jacqueline Bliley
Carnegie Mellon

Bogdan Conrad
Stanford University

2017 Honorable Mention Student Travel Award Recipients

Puneeth Shridhar
University of Pittsburgh

Radhika Vaid
North Carolina State University

Andrew Curry
University of Alabama at Birmingham

Samuel LoPresti
University of Pittsburgh

Seol-Ha Jeong
Seoul National University

Kosuke Yanagisawa
Osaka University

Bogdan Conrad
Stanford University

Minna Chen
University of Pennsylvania

Joshua Mealy
University of Pennsylvania

Samuel LoPresti
University of Pittsburgh

Jorge Jimenez
University of Pittsburgh

Stephanie Delgado
University of California
Los Angeles

Claire Witherel
Drexel University

Melissa Hernandez
University of California
San Diego

Elizabeth Aisenbrey
University of Colorado

Kevin Ortiz-Rivera
University of Minnesota

Joshua Hammer
Duke University

Pamela Graney
Drexel University

Margaret Schneider
University of Colorado
Boulder

Yuchen Wang
University of Rochester

Zheng Xiong
Syracuse University

Ayesha Aijaz
Rutgers University

Christopher Johnson
Georgia Institute of Technology

Karli Gold
Texas A&M University

Frances Lasowski
McMaster University

Do Hee Keum
Pohang University of Science and
Technology

Shoumyo Majumdar
Johns Hopkins University

Letícia Bins-Ely
Federal University of Santa Catarina

Mohammadhasan Hedayati
Colorado State University

From the President



Dave Kohn

This letter is my first since assuming the role of president. I will start by thanking you for allowing me to represent you. I also thank Liisa Kuhn for the great effort she put into leading the Society this past year and for the dedication that she and the Board and Council have to the Society. Maintaining

momentum on the heels of a great meeting is a challenge. By the time you receive this issue of the *Biomaterials Forum*, you hopefully will already have seen this letter in a personal email — a small but important way the Society is “modernizing” its communications.

This past year was eventful, culminating in the outstanding Annual Meeting in Minneapolis in April. I would like to thank the many sponsors and exhibitors who provided support and helped make this meeting a success. A huge thank you to our Program Committee chairs, Rebecca Carrier and SuPing Lyu, and the rest of the Program Committee who implemented a vision for a program that placed greater emphasis on the industrial arm of SFB. This was accomplished by creating a Biomaterials Technology in Industry track and emphasizing the importance of standards in biomaterials research. The program also included an increased number of plenary talks, outstanding talks from our award winners and symposia by thought leaders. We continued our partnership with other societies and held a U.S.–China workshop on regulations, standards and innovation. The Society has always embraced its student members and educational mission. We continued the Biomaterials Education Challenge (biomaterials.org/students/biomaterials-education-challenge), in which student teams were challenged to develop an educational module for middle school science classes. The winners of the competition were:

- 1st Place:** Texas A&M University with a prize of \$2,000
- 2nd Place:** University of Memphis with a prize of \$1,500
- 3rd Place:** Case Western Reserve University with a prize of \$500
- 3rd Place:** North Carolina A&T State University with a prize of \$500
- People’s Choice Award:** Texas A&M University with a prize of \$500

Another exciting component of the meeting was the third annual business plan competition. The winners were:

Audience Award (\$1,000)

#282: *20/20 OptimEyes: Drug Delivery Solutions to Improve Ocular Health*

Presenting Author: Frances Lasowski, McMaster University, Hamilton, ON

Judges Award (\$1,000)

#285: *The Rescue Stent for Non-Compressible Traumatic Hemorrhage*

Presenting Author: Puneeth Shridhar, University of Pittsburgh/University of Pittsburgh Medical Center, Pittsburgh, PA

This competition challenged students to consider the commercialization aspects of biomaterials research and was judged by experts from investing, industry, regulatory and academia on the strength of their commercialization plans. These education and business challenges speak to the diversity of our Society and our mission of training and facilitating the career development of the next generation of biomaterialists.

The meeting would not have been possible without the staff at Association Headquarters (ahredchair.com), especially Dan Lemyre, Deb Dupnik and Melanie Ryan, who organized and planned the meeting. Planning our meetings is a year-round process, and we have already started to plan the theme and program for next meeting, which will be held from Apr. 11–14, 2018, in Atlanta, Georgia. Program Committee Chairs Johnna Temenoff and Robert Hastings continue the partnering of academic and industrial leaders to craft a comprehensive program that reaches out to all sectors of our membership.

This coming year, our Society will continue to implement the strategic plan that was created by the Board and Council in 2015. The full plan can be found on our website at biomaterials.org/about/society-biomaterials-strategic-plan and consists of five domains: visibility, membership, meetings, education and professional development, and globalization. Liisa Kuhn gave a summary of what was accomplished

during her presidency at the Annual Meeting, and a video recording of her presentation can be viewed at biomaterials.org/publications/news/society-biomaterials-2016-2017-year-review-video-recording.

GOALS FOR THE UPCOMING YEAR

Within the domain of visibility, it is important to make energy in the field translate into energy in SFB. This will be accomplished by promoting both the Society and individual members, as well as marketing the uniqueness of biomaterials science and engineering, the centrality of SFB in defining this unique discipline, the scientific diversity of SFB and our emphasis on career development. We have charged a task force with evaluating how the Society will expand its web and social media presence to promote our activities, members' excellence and advocacy for science. With regard to the goal of increasing the value and quality of our meeting, no other organization in the biomaterials arena creates as diverse of a program and produces content that appeals to as broad a constituency of the biomaterials community as we do. In conjunction with the Young Scientist Committee/formerly Young Scientist Task Force (community.biomaterials.org/groups/young-scientist-committee) and the Industrial Affairs Committee (biomaterials.org/sigs-and-committees-sigs-and-committees-overview/devices-materials-committee), we will place an increased emphasis on career development aspects of the meeting. A workshop on bridging the gap between academic training and skills needed in an industrial career is already being planned. Ideas for the 2018 meeting are being solicited, and I encourage you to submit concepts for workshops and symposia.

With regard to the goal of developing and supporting a scientifically diverse membership represented by all sectors and increasing the value of membership, we are embarking on a more aggressive strategy for membership. This will be accomplished by better articulating the value of membership, "selling" the uniqueness of biomaterials science and engineering, defining the Society's role in training the next generation of biomaterialists and facilitating their career development. One example of an initiative geared toward career development is the advancement of a mentoring program in which student members will

be linked with senior members via a customized menu of mentoring activities. One of the most frequently asked questions by students relates to job prospects. In the domain of education and professional development, if we create the environment that nurtures the careers of biomaterialists and promotes SFB as body that best educates the next generation and grooms their career, I believe this will be a magnet for recruitment and retention.

With respect to the globalization of biomaterials, it is becoming increasingly important that the Society demonstrate its unwavering commitment to global science and advocate on behalf of science and its members. We are not a political organization, but we cannot remain silent when actions have the potential to compromise the interests of the scientific community. In this regard, we have partnered with the American Association for the Advancement of Science (aaas.org), the American Institute for Medical and Biological Engineering (aimbe.org) and an ad hoc scientific society CEO group on matters related to scientific advocacy.

In closing, our Society is vibrant and fiscally sound, members are engaged and collegial, and the Annual Meeting continues to be an excellent place to meet people and form long-lasting professional and personal bonds. We cannot be complacent, and we must meet the challenges of keeping our membership strong and ensuring that SFB remains the major society for the diverse group of people who consider themselves biomaterialists. We must also meet the challenges of the field, as well as external challenges that seek to compromise science and the interests of our members. I am confident that we can overcome these challenges.

I encourage you to keep in touch with me. I look forward to working with you this coming year, and please feel free to contact me (dhkohn@umich.edu) if you have any questions, thoughts or concerns about our Society.

David H. Kohn, PhD | Society For Biomaterials President

Members in the News

BY HELEN H. LU, MEMBER-AT-LARGE



Society For Biomaterials members: I am honored to serve as your 2017–2018 Member-at-Large. I will be YOUR representative on both SFB's Board of Directors and Council, and I will serve as your representative on other committees so that members have a clear voice for SFB's direction. I plan to focus my efforts on three areas: (1) effectively engaging and representing the membership, (2) encouraging scientific excellence and program relevance and (3) enhancing community building. With your help, we can help SFB grow and maximize the value of your membership, and I look forward to your ideas and feedback about SFB (please email me at hllu@columbia.edu).

This quarter's exciting member news and accomplishments include the following.

Joel Bumgardner, professor of biomedical engineering, is the recent recipient of over \$2 million in funding from the National Institutes of Health for his project titled "Chitosan Guided Bone Regeneration Membranes for Dual Local Delivery of Simvastatin and Raspberry Ketone."

Bikramjit Basu of the Indian Institute of Science, Bangalore, has been named a Fellow of the Indian National Academy of Engineering and a Fellow of the National Academy of Sciences India. Dr. Basu was also awarded the National Bioscience Award by the Department of Biotechnology, Government of India, which is conferred annually upon select Indian bioscientists younger than age 45 for unique contributions made in the frontier areas of biological sciences.

Michael Detamore is serving as the founding director of the Stephenson School of Biomedical Engineering at the University of Oklahoma (OU). Made possible by a historic \$30 million gift, the Stephenson School is completing its first year, with an inaugural class of freshmen and sophomores. Biomaterials is one of the school's primary focus areas, with faculty interests including nanomaterials for cancer and bioactive materials for regenerative medicine. The Stephenson School is actively recruiting junior and senior faculty and graduate students, with an emphasis on translational research, in collaboration with the OU Price College of Business, the OU Health Sciences Center and the Oklahoma Medical Research Foundation.

Jordan J. Green, associate professor of biomedical engineering, chemical and biomolecular engineering, materials science and engineering, ophthalmology, oncology and neurosurgery at the Johns Hopkins School of Medicine,

has received the 2017 American Society for Engineering Education Curtis W. McGraw Research Award. Green was recognized for his "outstanding research achievements in the fields of biomedical engineering, chemical engineering and materials science and engineering. In particular, for the discovery, development and engineering of innovative nanobiotechnology for intracellular delivery and biomimetic instructive materials as therapeutics." (See more at engineering.jhu.edu/news/2017/03/07/jordan-green-mcgraw-research-award/#.WReYK1LIR24).

Christopher Jewell, associate professor of bioengineering at the University of Maryland, has been named to the Associate Scientific Advisory Board of *Science Translational Medicine*, sister journal to *Science*. In addition to acting as advisors for the journal, associate scientific advisors select articles to highlight in the weekly Editors' Choice section of *Science Translational Medicine*. Each associate scientific advisor authors approximately eight articles per year to appear in *Science Translational Medicine*.

Jeff Karp, associate professor of medicine at Harvard Medical School, and a team of researchers from Brigham and Women's Hospital have published a study in *Cell Reports* that describes a technique to grow large quantities of inner ear progenitor cells that convert into hair cells. The same techniques show the ability to regenerate hair cells in the cochlea. The hair cells are directly responsible for detecting sound and helping to signal it to the brain, and their loss is the root cause for widespread hearing impairment. Until now, it was not possible to promote the generation of sufficient quantities of new hair cells. (See more at brighamandwomens.org/about_bwh/publicaffairs/news/pressreleases/PressRelease.aspx?sub=0&PageID=2626).

Floyd Karp (Washington University) and **Nicholas Ziats** (Case Western Reserve University), chair and vice-chair of the Biomaterial Tissue Interaction Special Interest Group (SIG), and *Journal of Materials Science Materials in Medicine* Clinical Editor **Antonio Merolli** (Rutgers University) are launching a Biomaterial Tissue Interaction in Humans SIG. Examining the interactions of biomaterials and tissues in humans can provide invaluable insights. Unfortunately, publication of analytical studies of retrieved implants can be challenging; for example, most are single case studies, and often the best conditions for implant retrieval are impractical to implement. For this reason, a dedicated space in the literature and a proper editorial handling should be welcome and will provide investigators an opportunity to share their results in the context of other studies in the area.

Joachim Kohn (New Jersey Center for Biomaterials, Rutgers University) organized a Thought Leaders Session at SFB's 2017 Annual Meeting. This innovative session format invited thought leaders in the field of biomaterials, such as **Thomas Barker** (University of Virginia), **Jan de Boer** (Maastricht University, Netherlands), **William Welsh** (Rutgers University) and **Carl Simon Jr.** (National Institute of Standards and Technology), to design a session around the topic of "Opportunities for Biomaterials Science in the Era of Materiomics," covering the current state of materiomics and, more specifically, biomateriomics. Discussion focused on current projects, challenges faced, potential solutions and areas for growth and development.

Dr. Kohn, Chair of the International College of Fellows, organized at SFB 2017 the International College of Fellows of Biomaterials Science and Engineering debate on the topic "Clinical Studies are the only True Predictor of the Safety and Efficacy for all new Medical Technologies." Three Fellows argued against this motion, advocating for in vitro, animal, and other test systems: **Jack Ricci** (New York University), **Paul Santerre** (University of Toronto), **Peter Ma** (University of Michigan). Three Fellows argued for the motion, attempting to persuade the audience that clinical trials are the only way to predict human clinical outcomes: **Frederick Schoen** (Harvard Medical School), **Michael Sefton** (University of Toronto), **Dave Grainger** (University of Utah). The topic proved to be really controversial and at the beginning, the two sides differed by only one vote. After the debate, the AGAINST side was declared the winner, though the margin of victory was only a few votes.

Dr. Kohn also writes that he and his associates at Rutgers University developed a combinatorial-computational approach to discover and optimize unique biomaterials compositions to advance coronary stent design. This work was recognized by SFB with a Clemson Award for Basic Research to Dr. Kohn and led to the formulation of a family of biodegradable, high-strength, biocompatible and X-ray-visible polymers, which became the foundation for the development of the world's first X-ray-visible polymer stent by REVA Medical, Inc. This work was highlighted by the National Institutes of Health (nibib.nih.gov/news-events/newsroom/amazing-disappearing-stent). In April 2017, this stent was approved for clinical use in Europe and is now being offered to patients in 26 countries. This is the first time a biodegradable polymer designed de-novo and optimized by computational property modeling has been used to enable the commercialization of a revolutionary medical product. In Europe, about 1.8 million angioplasties are

performed each year; hence, millions of patients may benefit from this new technology.

Melissa Krebs, assistant professor in the Chemical & Biological Engineering Department at Colorado School of Mines, was named the 2017 Colorado School of Mines Inventor of the Year. She has one issued patent and four others pending for her work in controlled drug delivery from biopolymers, bone and dental regenerative biomaterials, and biopolymer sensors for glaucoma monitoring; her work in these areas has attracted interest from companies ranging from startups to larger corporations.

Surya Mallapragada, Anson Marston Distinguished Professor and Carol Vohs Johnson Chair at Iowa State University, has been elected a Fellow of the National Academy of Inventors (NAI). Election to NAI Fellow status is the highest professional distinction, accorded solely to academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development and welfare of society. (See more at cbe.iastate.edu/blog/2017/04/10/high-honor-for-cbes-mallapragada-inducted-as-national-academy-of-inventors-fellow).

Tony Mikos, Louis Calder Professor of Bioengineering, Chemical and Biomolecular Engineering at Rice University, and his group will take part in a five-year, \$20 million effort to apply advanced manufacturing techniques to regenerative medicine, coordinated with the Wake Forest Institute for Regenerative Medicine, with the goal of expediting the availability of replacement tissue and organs to patients. (See more at news.rice.edu/2017/03/31/mikos-lab-aids-new-push-for-regenerative-medicine).

David Mills, professor at the School of Biological Sciences and the Center for Biomedical Engineering & Rehabilitation Science, has been named by the Research Council of Louisiana Tech University as the Outstanding Innovator for 2016–2017, in recognition of the many ROI, patents and licenses generated from his work just within the past three years.

Nicholas Peppas, Cockrell Family Regents Chair #6 in Engineering at the University of Texas at Austin, was elected to the American Academy of Arts and Sciences. (See more at che.utexas.edu/2017/04/13/professor-and-biomaterials-expert-nicholas-peppas-elected-to-american-academy-of-arts-and-sciences.) He was also honored with the inaugural Pioneer of Nanomedicine Award. (See more at che.utexas.edu/2017/02/20/pioneer-of-nanomedicine).

Dr. Peppas' recent research has also led to a better understanding of imprinting proteins. (See more at pubs.acs.org/doi/abs/10.1021/acs.biomac.6b01482.) He and **Ali Khademhosseini** have co-authored a piece for *Nature* on the call for safer biomaterials, a critical focus in the field. (See more at nature.com/news/make-better-safer-biomaterials-1.21136).

Suzie Pun, Robert F. Rushmer Professor of Bioengineering, has received the University of Washington College of Engineering's 2017 Faculty Award for Research. The award recognizes Dr. Pun's extraordinary dedication to research and the wide impact and scholarly distinction of her contributions. (See more at bioe.uw.edu/15-million-award-planned-for-center-for-dialysis-innovation/).

Buddy Ratner, professor of bioengineering and chemical engineering and the Michael L. and Myrna Darland Endowed Chair in Technology Commercialization at the University of Washington, is co-leading the new Center for Dialysis Innovation. Launched in November 2016, the center aims to use biomaterial and bioengineering technology to transform kidney dialysis care. (See more at bioe.uw.edu/15-million-award-planned-for-center-for-dialysis-innovation).

Qiaobing Xu, associate professor of biomedical engineering at Tufts University, received the Rising Star Award at the 2017 Biomedical Engineering Society (BMES) Conference, and he presented his work on "Efficient Delivery of Genome-editing Proteins Using Bioreducible Lipid Nanoparticles" at the BMES Cellular and Molecular Bioengineering conference in Hawaii in January 2017.

Guigen Zhang, professor of bioengineering at Clemson University, recently published a new textbook titled *Introduction to Integrative Engineering: A Computational Approach to Biomedical Problems* (Mar. 1, 2017, by CRC Press, ISBN 9781466572287). Written for junior- and senior-level undergraduate students in engineering and applied sciences, Zhang's book includes example problems primarily from the biomedical field. For graduate students and practicing engineers in industry and R&D labs, the book will be a valuable resource for finding and formulating solution and integrating ideas from complementary fields of engineering. The book will be useful for both novice and experienced modelers.

Staff Update

News & Updates

BY DEB DUPNIK, SFB ASSISTANT EXECUTIVE DIRECTOR



Hello from Society For Biomaterials Headquarters! We send our thanks and appreciation to the beautiful city of Minneapolis for hosting the 2017 Annual Meeting! With the beginning of a new program year, the Society's Board of

Directors, governing Council, committees, task forces and Special Interest Groups (SIGs) will be working to advance the Society's mission as described below.

Annual Meeting

The Society's Annual Meeting took place Apr. 5–8, 2017, in Minneapolis, Minnesota. Results of the spring election were announced, and the following individuals have been elected as officers for the SFB Board of Directors:

2017–2018 President-Elect: Andrés J. García, PhD, Georgia Institute of Technology

2017–2019 Secretary/Treasurer-Elect: Elizabeth Cosgriff-Hernandez, PhD, Texas A&M University

2017–2018 Member-at-Large: Helen H. Lu, PhD, Columbia University

The members present approved the recommendation from the Bylaws Committee to amend the bylaws to allow for:

1. Changing the name of the Devices & Materials Committee to the Industrial Affairs Committee
2. Eliminating the Long Range Planning Committee and giving the charges to the Council, as coordinated by the President-Elect
3. Eliminating the Meetings Committee and giving the charges to the Board
4. Contextual renumbering of the bylaws

In addition, Secretary/Treasurer Lisa Friis reported that the Society is in good health financially.

Election of 2017–2018 Awards, Ceremonies and Nominations Committee:

The following individuals were elected by the members present: David W. Grainger, PhD, University of Utah; Horst Von Recum, PhD, Case Western Reserve University; Guigen Zhang, PhD, Clemson University; and Alan S. Litsky, MD, ScD, The Ohio State University.

New Council: These members will be serving as chairs of committees and, along with the Board, will comprise the 2017–2018 Council:

COMMITTEE	CHAIR
Awards, Ceremonies and Nominations	Nicholas Ziats, PhD
Bylaws	Ben Keselowsky, PhD
Industrial Affairs (f/k/a Devices & Materials)	Peter Edelman, PhD
Education & Professional Development	Jan P. Stegemann
Finance	Elizabeth Cosgriff-Hernandez
Liaison	Tim Topoleski
Membership	Christopher Gehrman
President's Advisory	Liisa Kuhn
Program	Johnna Temenoff Robert Hastings
Publications	Sachin Mamidwar
Student Chapters	Daniel Hachim

Members elected or appointed to committees will be posted on the Society For Biomaterials website at biomaterials.org.

THE FOLLOWING COMMITTEE UPDATES ARE FROM THE 2016–2017 CHAIRS

AWARDS, CEREMONIES AND NOMINATIONS

CHAIR: ANTONIOS MIKOS, PhD

Results of the 2017 election were announced, and the following awards were presented during the Annual Meeting:

Founders Award: Jeffrey Hubbell, PhD, University of Chicago

C. William Hall Award: Jim Burns, PhD, Casebia Therapeutics

SFB Service Award: Joel Bumgardner, PhD, University of Memphis

Technology Innovation and Development Award: Len Pinchuk, PhD, Innovia, LLC

Clemson Award for Applied Research: Samir Mitragotri, PhD, University of California–Santa Barbara

Clemson Award for Basic Research: Shelly Sakiyama-Elbert, PhD, University of Texas at Austin

Clemson Award for Contributions to Literature: Ali Khademhosseini, PhD, Harvard Medical School

Young Investigator Award: Ankur Singh, PhD, Cornell University

Student Award for Outstanding Research — Undergraduate: Colleen O'Connor, University of Texas at Austin

Student Award for Outstanding Research — PhD: John Clegg, University of Texas

Student Award for Outstanding Research — PhD: Ricardo Londono, University of Pittsburgh

Outstanding Research by a Hospital Intern, Resident or Clinical Fellow Award: Mary Lyvers, University of Illinois

C. William Hall Scholarship: Meghan Wyatt, University of Pittsburgh

Cato T. Laurencin Travel Fellowship: Nicole Friend, University of California, San Diego; Jeremy Nortey, North Carolina State University; Taiwo Divinefavor Osinloye, University of Illinois at Chicago

BYLAWS

CHAIR: BEN KESELOWSKY, PhD

The Bylaws Committee presented its recommendations to the Council for changing the name of the Devices & Materials Committee to the Industrial Affairs Committee; eliminating the Long Range Planning Committee and giving the charges to the Council, as coordinated by the President-Elect; eliminating the Meetings Committee and giving the charges to the Board; and contextually renumbering the bylaws. After some discussion, the proposed amendment passed with overwhelming support.

EDUCATION & PROFESSIONAL DEVELOPMENT

CHAIR: ELIZABETH COSGRIFF-HERNANDEZ, PhD

Since the fall Council meeting, the Education & Professional Development Committee has evaluated nominations for the C. William Hall Award, the Cato T. Laurencin Travel Fellowship, the STAR program and Student Chapter travel grants. The Young Scientist Committee was formed under the purview of the Education & Professional Development Committee, providing a melting pot for career development ideas where senior members can guide graduate students, post-doctoral students and junior faculty on the path toward impactful research and outreach, fulfilling an unmet need within the biomaterials community. If you are just starting out in your career, are less than 10 years from earning your terminal degree and want to be part of this exciting new group, please contact SFB Headquarters at info@biomaterials.org.

FINANCE

CHAIR: SHELLY SAKIYAMA-ELBERT, PhD

Income and expenses are in line with projections, and the Society is in good health. SFB received an unqualified opinion (“clean”) audit report for 2016. The financial position of the SFB as of Dec. 31, 2016, and the changes in its net assets and its cash flows for the year were prepared in accordance with U.S. generally accepted accounting principles.

MEETINGS

CHAIR: NICHOLAS ZIATS, PhD

The following meeting locations have been approved by the Council: 2018 Hilton Atlanta in Atlanta, Georgia, and

2019 Washington State Convention Center in Seattle, Washington. Plans are being considered for a 2020 Fall Symposium.

MEMBERSHIP

CHAIR: LIJIE GRACE ZHANG, PhD

Current membership stands at 1,055, which is up from the last two years; this time last year, membership was 869, and in 2015, membership was 943. Membership renewal reminder emails were sent every other week to members whose membership had expired in 2015 and 2016, and similar emails were also sent to those whose memberships had lapsed in 2013 or 2014. Lapsed members were also sent a survey asking them why they had not renewed and what benefits would be valuable to them. Membership postcards, pop-up banners with member benefits and copies of *Biomaterials Forum* will continue to be displayed at all 2017 Biomaterials Day events. Using strategies outlined by the Association Headquarters Marcom team, enhancements have been made to the SFB website “join” pages, outlining member benefits and listing all of the member types available, as well as fees. SFB Headquarters staff will also be working closely with Association Headquarters’ Marcom team over the next year to focus efforts on turning prospects that are already in our database into members.

PROGRAM

CHAIRS: SUPING LYU, PhD, AND REBECCA CARRIER, PhD

SFB’s 2017 Annual Meeting closed on April 8 after three-and-a-half days of active meetings and interactions at the Minneapolis Convention Center in Minnesota. The area is a hub of medical technology, which was reflected in this year’s meeting: Translational research and meaningful innovation were brought to new heights in the three-day Biomaterials Technology in Industry track and number of sessions, panels, workshops and plenary speeches involving U.S. Food and Drug Administration and industrial speakers. Many participants had opportunities to visit Medtronic PLC and Boston Scientific facilities and communicate with people from the local companies. Of course, the traditional focus of the SFB conferences — active agent delivery, tissue engineering, orthopedic biomaterials and biointerface — has been placed well, especially with the Thought Leader Symposia, which presented six sessions organized by leaders and invited speakers on leading-edge research as well as perspective and overview of the fields. In total, 1,065 people registered for the conference, and there were 516 poster and 439 oral presentations. Thanks to the 2017 Program Committee, especially Drs. Rebecca Carrier and SuPing Lyu, for putting this program together. Abstracts from the meeting have been posted online at abstracts.biomaterials.org.

PUBLICATIONS

CHAIR: SACHIN MAMIDWAR, MBBS, MS

The Publications Committee reported that the Society’s publisher of the *Journal of Biomedical Materials Research*, Wiley, has transitioned *JBMR A* and *B* to online form only, and there have been no complaints. The journal is healthy, and impact factors are up. Since the transition to electronic delivery only, downloads have increased. There has been some discussion about beginning work on the next edition of the preeminent textbook in the field, *Biomaterials Science*, which is published by Elsevier. The book’s editors are discussing options with the publisher and the Society.

STUDENT CHAPTERS

PRESIDENT: CHRISTOPHER GEHRMANN

The 2017 Student Luncheon in Minneapolis was joined by Invited Speaker Dr. Randall Ribaud from SciPhd. His talk focused on presenting our students with skills to help prepare them for a career in industry. Dr. Ribaud’s interactive discussion helped our graduate students find the best methods for attacking job postings and best presenting themselves as the intelligent team players that SFB members are known to be. With a new perspective on the job application process, we hope to see our student members succeeding professionally during these difficult transitional periods. Students who join SFB continue to receive complimentary membership to all SIGs they choose.

SIGS

REPRESENTATIVE: BRENDAN HARLEY, PhD

Newly elected officers for 2017–2019 will be announced after the Annual Meeting. The new SIG representative to the Board of Directors (Sarah Stabenfeldt) has established the following priorities for each of the SIGs:

- Submit budget proposals by August 2017
- Submit session ideas for the 2018 Annual Meeting by June 2, 2017
- Appoint student, web, forum and industry representatives (all SIGS)

If you have any questions, require any information or have suggestions for improved services, please feel free to contact the Society’s headquarters office:

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biomaterials.org

BY DANIEL HACHIM, STUDENT CHAPTER PRESIDENT, WITH CHRISTOPHER GEHRMANN



Emily Lurier, a doctoral student in **Kara Spiller's** lab at Drexel University, recently received a Fulbright fellowship and a Whitaker fellowship to conduct research beginning this fall in the lab of Dr. Carlijn Bouten at the Eindhoven University of

Technology in the Netherlands. Lurier's PhD research focuses on modulating the inflammatory response to bioprosthetic heart valves to extend their longevity. She will use her time in the Netherlands to conduct preclinical studies.

Lisa Tostanoski, National Science Foundation Graduate Fellow in **Christopher Jewell's** lab at the University of Maryland, has received the \$15,000 Lemelson-MIT Cure it! Prize. The Lemelson-MIT student prize honors the nation's top collegiate student inventors in economy, healthcare, transportation, food and agriculture and consumer devices. Tostanoski received the Cure it! Prize for her projects using biomaterials to promote immune tolerance and combat autoimmune disease. She will travel to Boston this June for the award ceremony during EurekaFest.

Vision for 2017-2018

The student council for the 2016-2017 year is proud to pass on the reigns to our newly elected officers and support their new vision. With the inclusion of a large, successful workshop on creating industry skills for graduate students by SciPhD, we hope to set a high bar for the SFB's Student Chapter to continue providing great opportunities for our members. In the past year, we have also hosted multiple Biomaterials Days, including one recently at the University of Florida, one of the Society's most active chapters and home of our new President-Elect, Maggie Fettis.

The new student council is already off to a great start with local Biomaterials Days scheduled across the nation throughout the next year, providing additional opportunities to meet fellow members and creating new networking and presentation opportunities. The locations for the next year and beyond currently include the University of Texas at Austin on June 2, 2017; Vanderbilt at Nashville on Aug. 4, 2017; North Carolina State at Raleigh on Sept. 1, 2017; and Florida State University at Tallahassee on Feb. 23, 2018.

Daniel Hachim, a PhD candidate in bioengineering at the McGowan Institute for Regenerative Medicine and the Bioengineering Department at the University of Pittsburgh, assumed the presidency of the Student Chapter for 2017-2018. He graduated with degrees in chemistry

and pharmaceutical sciences from the Pontifical Catholic University of Chile in 2010 and became a research associate and adjunct assistant professor in pharmaceutical technology at the same university for the following two years. In 2012, he was awarded with Fulbright and Chile Government fellowships to pursue his graduate studies in the United States. Hachim is currently working on multiple projects that use drug delivery, surface engineering and ECM-derived scaffolds for tissue engineering applications, immunomodulation and the host response against biomaterials.

Hachim has the following message to our students and members: "I am honored to represent all the interests of the student body and to contribute to the growth of this society. The Society For Biomaterials has outstanding resources available that may be used to accomplish many career and research goals, and one of my priorities as president is to facilitate both information and access to these resources to student members. In addition, we will continue the great work of the previous student officers by promoting a collaborative environment, development opportunities and networking activities for students, faculty and university chapters. Finally, the involvement of students in the society is critical for the success and mission of our student body; therefore, different approaches will be studied, proposed and implemented to promote student involvement."

Figure 1. SFB 2017-2018 Student council



From left: Allison Post, Maggie Fettis, Marc Thompson, Leslie Pace, Christopher Gehrmann and Daniel Hachim.

UNDERGRADUATE RESEARCH HIGHLIGHTED AT ANNUAL MEETING

BY AMBER JENNINGS, HERFF COLLEGE OF ENGINEERING, DEPARTMENT OF BIOMEDICAL ENGINEERING



Each year, many students in biomaterials-related fields present their research findings at the Society For Biomaterials Annual Meeting. While the majority of participants are graduate level, a growing number of entries are from students who have

contributed to research at the undergraduate level. This year, in addition to the Student Award for Outstanding Research — Undergraduate, the Education Special Interest Group (SIG) organized a competition to highlight student research with undergraduates as first authors and presenters. Students identified their eligibility during the abstract submission process, and there were 37 entries this year. Abstracts and presentations were judged on scientific content and presentation.

Three winners were selected out of the many outstanding entries. The first-place award of \$200 went to Elisha Early from Michigan Tech with her presentation of “Regulation of the Chronic Arterial Inflammatory Response to Biodegradable Zinc-Based Implant Materials by Corrosion.” The second-place award of \$150 went to Michaela Cooley from Case Western Reserve University for her presentation of “Effect of Particle Shape and Size on Margination and Wall-Localization in Vascular Drug Delivery.” Third place and \$100 went to Blake Lash from the Georgia Institute of Technology for his presentation of “Imidazole-Modified Chitosan Nanoparticles for Delivery to Lung Epithelial Cells in Air-Liquid Interface Cultures.” The Student Award for Outstanding Research — Undergraduate went to Colleen O’Connor from the University of Texas at Austin, who presented a poster on “Development and Characterization of Stimuli-Responsive Hydrogel Microcarriers for Oral Protein Delivery.”

Research on educational outcomes has shown that undergraduate research experience has a significant impact on leadership skills that translate into increased preparedness for future professional careers.^{1,2} Research experiences also improve student grasp of ethical issues and their role in decision-making.¹ Undergraduate research not only provides benefit for students but also student peers, faculty and future employers.³ Studies have shown that 68 percent of undergraduates who researched gained more interest in science, technology, engineering and math (STEM), while only 8 percent lost interest in STEM.⁴ The number of undergraduates who expected to pursue a PhD in their fields before college greatly increased after gaining research experience.⁴ This trend has particular impact for broadening participation of underrepresented students.⁵

Engaging students in research is a worthwhile endeavor, but it also may be limited in schools with large student populations or limited resources for funding or faculty mentors.¹ While most institutions offer limited experiences for select students, some institutions have been successful at incorporating undergraduate research into required curriculum.⁶⁻⁸ A recent article by Linn et al highlights the difficulties in designing and measuring outcomes of undergraduate research experiences, because most assessments are self-reported interviews and could be skewed.⁹ Guidelines for developing meaningful research experiences and assessment of outcomes have been reviewed by Butler et al.¹⁰ The National Science Foundation has long recognized the value of this experience, and several institutions offer Research Experiences for Undergraduates programs.^{6,11} Principal investigators may also explore opportunities for funding educational activities through National Institutes of Health mechanisms, such as Academic Research Enhancement Awards. The National Council for Undergraduate Research also provides resources and funding for undergraduate experiences in STEM fields⁷ and holds a yearly national conference to showcase undergraduate research (cur.org).

(continued on page 17)

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EXCITING TIME TO BE A TISSUE ENGINEER

BY MELISSA KREBS, PhD, COLORADO SCHOOL OF MINES, GOLDEN, CO, JEFFREY JACOT, PhD, UNIVERSITY OF COLORADO, AURORA, CO AND SYAM NUKAVARAPU, PhD, UNIVERSITY OF CONNECTICUT HEALTH, FARMINGTON, CT



Melissa Krebs

Technical Sessions at the 2017 Annual Meeting

The Tissue Engineering Special Interest Group (SIG) sponsored many interesting sessions this year at the 2017 Annual Meeting. These sessions included presentations ranging from biomaterials just being developed all the way to translation and commercialization of biomaterials for various applications. Some sessions focused on tissue engineering, organoid development and evaluation of tissue engineering constructs, covering regeneration strategies for bones, cartilage, ligaments, cardiac valves and salivary glands. Other talks focused on sensing and measuring what was occurring within a tissue or its surroundings, like monitoring oxygen levels. There were also sessions on therapeutic drug delivery, where novel biomaterial systems are being developed for controlled and sustained delivery of various biofactors, including

genetic material, proteins and small molecules. Some of these delivery systems are stimuli-responsive, releasing the drug of interest only when triggered under the appropriate environmental conditions.

The Tissue Engineering SIG also sponsored a 3D bioprinting session, where new strategies for 3D printing of materials and cells were discussed. In addition, there were several sessions on the translation and commercialization of tissue engineering products focusing on translational research either at universities or in collaboration with companies, including materials for shunts; stroke recovery; soft and hard tissue repair; biopolymers to prevent tissue adhesions; osteoinductive materials; 3D cell culture matrices; and infection-responsive, drug-loaded coatings.

Social Mixer

The Tissue Engineering SIG, partnering with the Drug Delivery, Nanomaterials and Immune Engineering SIGs, held a social mixer on the evening of Apr. 7 at Hell's Kitchen in

downtown Minneapolis. The event was very well attended, with over 150 members present. Attendees enjoyed drinks — including an excellent selection of local beers — as well as a spread of hors d'oeuvres featuring fried cheese curds, a local favorite. This event provided several hours of networking and exchanging ideas among attendees from these related and interdisciplinary areas of biomaterials research.

Tissue Engineering SIG Meeting and Future Programming

During SFB's Annual Meeting in Minneapolis, a room full of active SIG members gathered to talk about the Tissue Engineering SIG's business and programming for the upcoming year. The meeting started with a brief discussion on the programs developed by the Tissue Engineering SIG in the last year. The most notable one was the Biomaterials Symposium during TERMIS-AM 2016. This discussion was followed by a vote of thanks to the outgoing officers.

The group then discussed how to offer the most value to its membership. Based on an extensive discussion, the group agreed on the following programs: (1) continuing student involvement by having students co-chair sessions and providing them with SFB STAR/STAR Recognition Awards, (2) providing opportunities to students and faculty to participate in the Annual Meeting by contributing sessions and (3) providing cutting-edge content by offering advanced scientific sessions that benefit researchers, clinicians and industry professionals involved in biomaterials science and tissue engineering research. Another topic of discussion was the type of sessions allowed and their submission timelines to ready the membership for the next cycle.

We think everybody enjoyed the meeting and was excited to be part of the discussion. For those of you who could not attend the meeting, please contact Tissue Engineering SIG chair, Syam P. Nukavarapu, PhD at syam@uchc.edu with your questions or suggestions.

Industry News

BY STEVE LIN, INDUSTRIAL NEWS EDITOR



Medical device maker **Zimmer Biomet Holdings Inc.** agreed to pay more than \$30 million to resolve Department of Justice (DOJ) and Securities and Exchange Commission (SEC) investigations into the company's "repeat" violations of the Foreign

Corrupt Practices Act. Under a deferred prosecution agreement with the DOJ, Zimmer Biomet will pay a criminal fine of \$17.46 million and retain an independent compliance monitor for three years. The Warsaw, Indiana-based company also agreed to pay the SEC \$13 million, consisting of \$6.5 million in disgorgement and interest and a \$6.5 million penalty. The SEC settled what it called "repeat" violations through an internal administrative order and didn't go to court.

A judge in the U.S. District Court for the Southern District of California granted a motion for class certification, appointing Brad Mass and Daniel Popov as class representatives, according to court documents. The class action suit is on behalf of investors who purchased **NuVasive** shares between Oct. 22, 2008, and July 30, 2013. Plaintiffs in the suit allege that the company submitted false claims to Medicare and Medicaid in violation of state laws and regulations and that the company made illegal kickbacks to doctors and engaged in off-label promotion of its products and services, according to court documents. NuVasive paid approximately \$13.5 million in fines and penalties related to the alleged actions, according to the plaintiffs, while shareholders "suffered significant losses and damages," according to court documents.

Boston Scientific Corporation announced a definitive agreement to acquire **Symetis SA**, a privately held Swiss structural heart company focused on minimally invasive transcatheter aortic valve implantation devices, for \$435 million in up-front cash. The Symetis portfolio includes the ACURATE TA and ACURATE *neo*/TF valve systems for use in the treatment of high-risk patients suffering from severe and symptomatic aortic valve stenosis, which are sold in Europe and in other geographies outside of the United States. Symetis is also developing the ACURATE *neo*/AS next-generation valve system, currently in a clinical trial intended to serve as the basis for a future CE mark application. This agreement to acquire Symetis follows the recent acquisition by Boston Scientific of certain Neovasc, Inc. manufacturing assets and demonstrates the company's continued investment in structural heart through intellectual property, R&D and manufacturing capabilities.

Stryker Corp. plans to grow its presence in its home state of Michigan with a new \$130 million corporate campus that's expected to create 105 jobs over the next three years. Set to

break ground in late spring 2017 in Portage, not far from the orthopedics company's headquarters in Kalamazoo, the 485,000-square-foot campus will include a customer experience center, showroom and lab space for R&D and other functions, as well as room for sales, marketing and support staff for Stryker's growing medical instruments division. Stryker had considered other locations in other states for the expansion but may have been swayed by incentives from the state of Michigan. The company was awarded a \$1 million grant for the project through the Michigan Business Development Program and may ask the state for more.

The Trump administration could cut \$5.8 billion from the 2018 budget of the National Institutes of Health (NIH), yet still fund at least as much research by eliminating overhead payments to universities and research institutions, Secretary of Health and Human Services (HHS) Tom Price told lawmakers. The hearing, before the appropriations subcommittee in the U.S. House of Representatives that oversees the HHS budget, included several questions about the 18 percent cut to NIH's \$31.7 billion budget that President Trump has proposed. (An addendum to that request also included a proposed cut of \$1.2 billion in the current fiscal year.) Cuts of that size have outraged biomedical research groups and drawn opposition from both Democrats and many Republicans in Congress. The chairman of the subcommittee, Representative Tom Cole (R-OK), said that "this committee, and certainly me personally, will be very hesitant about" the proposed cut to NIH and other parts of HHS.

President Trump's "skinny" budget proposes "recalibrating" the U.S. Food and Drug Administration's (FDA) user fee programs for medical products, requiring the life sciences industry to pay about \$1 billion more in fees to cover regulatory reviews and inspections. The user fee programs — which cover drugs, generic drugs, medical devices, biosimilars and veterinary products — help speed product reviews by allowing the FDA to hire additional staff and invest in technology. As of FY 2017, the fee for a company to submit a new drug with clinical data was just over \$2 million. The fee increase would help offset a 17.9 percent reduction in federal HHS funding. The White House wrote in its budget that "in a constrained budget environment, industries that benefit from FDA's approval can and should pay for their share."

Liquidmetal® Technologies, Inc. (LQMT) announced that its alloy LM105 has passed additional prescreening biocompatibility tests for use in medical implants and is now pursuing collaborations with medical implant companies. In February 2017, LQMT received long-term

implantation results from parts 3, 10, 6 and 11 of the ISO 10993 (Biological Evaluation of Medical Devices) suite of tests, which include evaluation of genotoxicity, subchronic systemic toxicity and pyrogenicity. LQMT alloy LM105 passed all of these tests well within the allowable limits. These results — combined with previously completed tests from ISO 10993 parts 10, 11, 4 and 5, which cover sensitization, irritation, acute systemic toxicity, hemocompatibility and cytotoxicity — indicate that the alloy LM105 is compatible with a wide range of medical device requirements, including long-term implants.

Almost a year after its draft guidance proposing public notification of emerging signals for post-market medical devices, the FDA is issuing final guidance putting the policy in place. The agency intends for emerging signals to give patients and physicians the latest information about the risks and benefits of medical devices on the market, but device manufacturers and industry groups voiced their opposition to the idea earlier this year. The agency defines an emerging signal as evidence of “a new causal association or a new aspect of a known association between a device and an adverse event or set of adverse events” that could be meaningful to patient management or the device’s benefit-risk profile. The FDA plans to determine what is an emerging signal by collecting information, working with device manufacturers, conducting an expert review and bringing in other stakeholders, including oversight by management, according to the guidance document.

Organogenesis Inc., a company in the field of regenerative medicine, is expanding beyond wound care with the acquisition of **NuTech Medical**. The newly combined company

will offer a portfolio of advanced and next-generation products for the wound care and surgical biologics markets. Based in Birmingham, Alabama, NuTech Medical is an emerging player, offering a diverse portfolio of amniotic products for a variety of surgical and wound care needs. NuTech Medical’s non-biologics product line will remain as a separate company, NuTech Spine. NuTech Medical’s portfolio includes an amniotic product line for both soft tissue and bone applications used in multiple markets, including wound healing and surgery. The product line includes Affinity, a novel, fresh amniotic allograft; NuShield, a dehydrated terminally sterilized allograft that comprises both the amnion and chorion layers; and NuCel and ReNu, cryopreserved allografts derived from human amnion and amniotic fluid, as well as other complementary products.

The global sports medicine devices market is expected to exceed more than \$9.3 billion by 2022 and will grow at a compound annual growth rate of more than 8 percent in the given forecast period, according to a report by Market Research Engine. Sports medicine is a branch of medication that focuses on the prevention and treatment of injuries incurred during sports activities. The major driving factors of the global sports medicine devices market are as follows:

- Increasing demand for outpatient services
- Increasing awareness regarding the maintenance of an active lifestyle
- Advocating for minimally invasive surgeries
- Changing the reimbursement landscape for new surgical technologies



CALL FOR COVER ART

WE WANT TO FEATURE YOUR EXCITING BIOMATERIALS ARTWORK ON THE COVER OF BIOMATERIALS FORUM.

Deadline: Accepted on a rolling basis.

Instructions: Please email artwork (digital images, artistic creations, etc.) to SFB headquarters and the Executive Editor of the *Biomaterials Forum*, Guigen Zhang, info@biomaterials.org, GUIGEN@clemson.edu. All artwork with biomaterials relevance that have not appeared as a Forum cover are welcome. Multiple submissions are permissible.

Selection Process: All submissions will be reviewed by the *Biomaterials Forum* Executive Editor. Selected artwork will appear as the cover of a future issue of *Biomaterials Forum* along with a brief “On the Cover” description of the subject and name/affiliation of the creator.

Format: High-resolution electronic version in .gif, .tiff, or .jpeg file format.

INTEGRATING ART INTO STEM EDUCATION: STEAM

BY YUSUF KHAN, EDUCATION NEWS CONTRIBUTING EDITOR



In previous columns, we have discussed the notion of science, technology, engineering and math (STEM) education, its necessity and its impact on educating under-represented minorities. In recent years, there has been an effort to integrate art into

STEM education, referred to as STEAM. The notion of formally integrating art into STEM education was put forth at a National Science Foundation–funded conference in 2011 at the Rhode Island School of Design. The workshop, entitled “Bridging STEM to STEAM: Developing New Frameworks for Art-Science-Design Pedagogy,” collected experts from science, engineering, math, art and design fields to examine and evaluate the gap between art and science and how that gap could be connected. The impetus for this workshop and the subsequent development of STEAM as a collected effort arose in part from the realization that, despite its dissimilar appearance to the casual observer, art and science are quite similar — perhaps different sides of the same coin.

Many articles have been written about the link between art and science; as scientists and engineers, many of us can attest to their similarities: using creativity, exploration or open-ended inquiry¹; looking at familiar things in new ways; developing new protocols and technologies; or using new materials in new ways to arrive at a vision,² to name a few. An interesting paper appeared in *Science* in 2011 that suggested that students learning science should be encouraged to draw as part of the process of learning.³ Proponents of this approach noticed that students would become disengaged from science due to “rote learning and traditional topics,” reducing the students to passive participants in the learning process, but drawing as part of the learning process lifted them from the passive role.³ Asking students to draw an example of what they had recently learned involved the translation of the written into “an inspectable form”³ that required an understanding of the topic beyond simple reiteration.

Many K–12 schools (and even some preschool programs) are integrating the concept of STEAM into their curriculum with examples, exercises and lesson plans from leading STEM organizations. It is even appearing in different forms on college campuses. In 2008, the University of Virginia

sponsored the Science & Art Project, which sought to encourage collaborations between scientists/engineers and artists by providing an infrastructure through which participants from these two distinct areas of interest could connect. More recently, the Alliance for the Arts in Research Universities, a partnership made up of over 30 universities, was founded to promote many objectives related to supporting interdisciplinary research and the role of the arts in the process. While not a formal nod toward the STEAM concept, the National Science Foundation Emerging Frontiers in Research and Innovation Office funded grants under its Origami Design for Integration of Self-Assembling Systems for Engineering Innovation initiative that examined how origami engineering, a true example of the intersection of art and engineering, could be used to create self-assembling systems. So, perhaps art is already an integral part of STEM. The challenge may lie in more clearly understanding the integration and harnessing it to stimulate education and innovation.

Education Quote of the Month:

“ART WITHOUT ENGINEERING IS DREAMING. ENGINEERING WITHOUT ART IS CALCULATING.”

—STEVEN K. ROBERTS

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SFB 2018 Award and Officer Nomination – Letter of Intent – July 14

News & Updates

The Awards, Ceremonies and Nominations Committee is soliciting nominations for the 2018 awards (biomaterials.org/awards/awards-descriptions) listed below and for the positions of President-Elect and Member-at-Large for the 2018–2019 term.

2018 Awards

- Founders Award
- C. William Hall Award
- SFB Award for Service
- Technology Innovation and Development Award
- Young Investigator Award
- Clemson Award for Basic Research
- Clemson Award for Applied Research
- Clemson Award for Contributions to the Literature
- Student Award for Outstanding Research (PhD, Masters and Undergraduate)
- Outstanding Research by a Hospital Intern, Resident or Clinical Fellow Award

Student Awards

Applications will be accepted for the following student awards beginning in August:

- Cato T. Laurencin Travel Fellowship (biomaterials.org/awards/cato-t-laurencin-travel-fellowship) (applications due Dec. 1, 2017)
- C. William Hall Scholarship (biomaterials.org/awards/c-william-hall-scholarship) (applications due Dec. 1, 2017)

Deadlines

The 2018 award nomination deadline is Friday, Sept. 15, 2017; however, nominators are encouraged to submit a letter of intent to nominate to Headquarters by July 14. Although a letter of intent is not required and is not binding, the information that it contains will permit the Awards, Ceremonies and Nominations Committee to identify awards and positions for which apparent nominations are not forthcoming and to solicit specific nominations as needed. Nominations will be accepted in September regardless of the receipt of a letter of intent.

To submit a letter of intent to nominate, please include your contact information, the name of the candidate and the award or position for which the nomination will be made in an email to info@biomaterials.org.

Please contact SFB Headquarters at 856-642-4201 or info@biomaterials.org with any questions or concerns.

Updates from the Education SIG (continued)

News & Updates

This was the first year that the Education SIG has sponsored additional undergraduate awards and recognition at the Annual Meeting. The organizers hope that the awards recognize and promote the valuable experiences gained by undergraduates in performing and presenting scientific research. The continued support of undergraduate research and exposure to presentations at national scientific meetings are beneficial to students, faculty and the SFB.

One of the goals of the Education SIG for the years ahead is to provide resources and program content to faculty members interested in providing undergraduate research experiences. The Education SIG is working to

develop content through workshops, webinars or online resources to help researchers find funding opportunities or incorporate undergraduate research experiences into research proposals. Society members are encouraged to send suggestions for resources and programming, opportunities for undergraduate research opportunities and successful strategies for incorporating undergraduate research into curriculum to the Education SIG so that we may publicize them to other members of the biomaterials community.

Highlights from the 2017 International Biomaterials Symposium – China at Clemson

As we all know, Clemson University is the birthplace of the field of biomaterials and the Society For Biomaterials. From 1969 to 1974, the first through sixth International Biomaterials Symposia (IBS) were held at Clemson, laying the groundwork for the establishment of the SFB. The seventh IBS in 1975 at Clemson marked the first SFB Annual Meeting. Some well-known SFB traditions, such as the Biomaterials Bash and the recognition of the highest accomplishments of SFB members in the name of the prestigious Clemson Awards, started at Clemson during this time. For example, the Biomaterials Bash started during the 1972 meeting, and the first set of three Clemson Awards were given during the 1973 meeting (Figure 1).

Honoring the global biomaterials community and Clemson's tradition in biomaterials research and education, the Clemson IBS have now evolved into a country-themed platform to highlight our collaboration with biomaterials scientists and engineers around the globe. The 2017 IBS at Clemson, a China-themed symposium, was held Apr. 9 and 10, immediately following SFB's 2017 Annual Meeting.

This symposium brought to Clemson distinguished Chinese scholars and entrepreneurs in biomaterials to share their advanced research and translational work, explore collaborations with faculty and fellow attendees and brainstorm opportunities for building global partnerships. The symposium featured Prof. Xingdong Zhang of Sichuan University of China, president of the International Union of Societies for Biomaterials Science and Engineering, member of the Chinese Academy of Engineering, associate member of the U.S. National Academy of Engineering and winner of the 2015 Clemson Award for Applied Research. The symposium also featured a plenary talk by Prof. Kam Leong of Columbia University, a member of the National Academy of Engineering and winner of the 2012 Clemson Award for Applied Research.

Other delegates included scholars from China and the United States, including Profs. Changyou Gao from Zhejiang University, Ray Han from Peking University, Hai Lin from Sichuan University, Zhen Gu from the University of North Carolina at Chapel Hill and North Carolina State University, and Bingyun Li from West Virginia University, as well as Dr. Qin Liu, CEO of Beijing Advanced Medical Technologies.

The two-day symposium started with a tour of the Clemson campus in the afternoon of Sunday, Apr. 9, the day Clemson

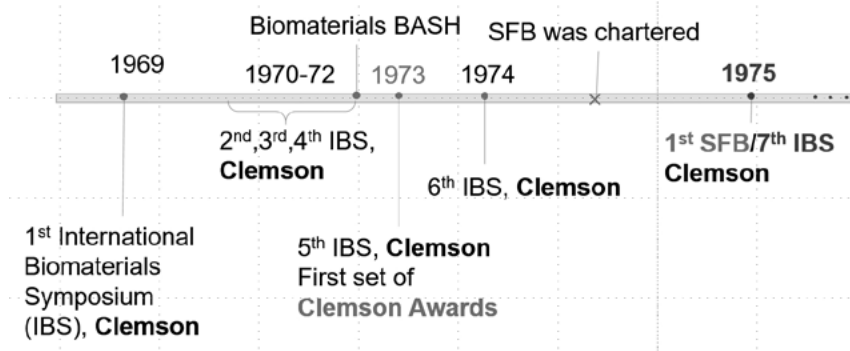
celebrated its annual International Day. During the tour, delegates tasted food samples from around the world prepared by Clemson's international students. High points of the tour included the greeting of the delegates by Clemson Vice President for Academic Affairs and Provost Dr. Robert Jones (Figure 2) and group photos with the Clemson House (Figure 3) and Rhodes Research Center (Figure 4). Clemson House is the "high-rise building in the 1960s" where the first to sixth IBS and first SFB Annual Meeting were held (unfortunately, it is slated to be demolished soon to make space for new buildings), and Rhodes Research Center is the home of the Department of Bioengineering. After the campus tour, delegates toured the nearby city of Anderson and dined at the Sake Zen Restaurant by Lake Hartwell to close the day.

The symposium, chaired by Prof. Guigen Zhang, began with opening remarks by our distinguished guest of honor, Prof. Xingdong Zhang, in the morning of Monday, Apr. 10, followed by technical presentations. Two technical oral sessions — "Biomaterials Science and Translation" and "Micro and Nano Technologies for Enhanced Biomaterials" — were scheduled in the morning, with a coffee and social break in between. The plenary presentation by Prof. Kam Leong was scheduled during lunch. The third oral session, "New Frontiers of Bioengineering and Globalization," began immediately after lunch and closed with a presentation by Prof. Martine Laberge on the Clemson Bioengineering and Global Partnership. The oral presentation part of the symposium was capped by the presentation of a model Clemson Tiger to Prof. Xingdong Zhang, a tiger himself per the Chinese zodiac signs (Figure 5).

After the oral sessions came the poster session, where some 30 posters by Clemson students (Figure 6) — and one from a high school student — were presented to encourage in-person interactions and discussions among attendees. Many Clemson faculty participated in the event and presented their work at the symposium, including Robert Latour, Naren Vyavahare, Hai Yao, Hai Xiao, Ying Mei, Jeoungsoo Lee and Tong Ye.

The dinner event at Blue Heron Restaurant and Sushi Bar in downtown Clemson marked the closing of the symposium. Many Clemson faculty joined the delegates at the dinner to celebrate a successful China-themed IBS at Clemson and the 80th birthday of Prof. Xingdong Zhang by sharing a Southern-style birthday cake (Figure 7).

Figure 1.



Historical timelines of the first to sixth IBS and the first SFB Annual Meeting held at Clemson.

Figure 2.



Greeting by Clemson's provost during the campus tour on International Day. From left, Wanlu Zhao, Qin Liu, Xingdong Zhang, Guigen Zhang, Robert Jones (Clemson's provost), Bingyun Li and Changyou Gao.

Figure 3.



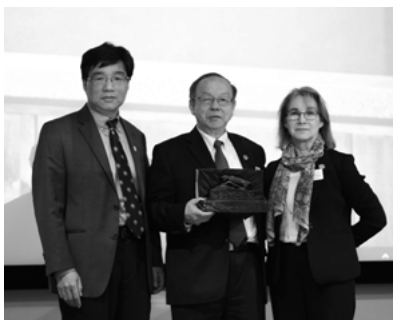
Catching a glimpse of history with the famous Clemson House in the background. From left, Wanlu Zhao, Bingyun Li, Xingdong Zhang, Guigen Zhang, Qin Liu, Changyou Gao and Hai Lin.

Figure 4.



In front of the Rhodes Research Center. From left, Qin Liu, Changyou Gao, Guigen Zhang, Xingdong Zhang, Bingyun Li, Wanlu Zhao and Hai Lin.

Figure 5.



Honoring a tiger with a miniature model of Clemson Tiger. From left, Guigen Zhang, Xingdong Zhang and Martine Laberge.

Figure 6.



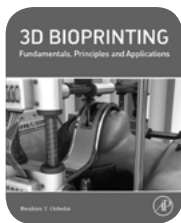
Group photo of symposium attendees with delegates.

Figure 7.



Celebrating Xingdong Zhang's 80th birthday at Blue Heron Restaurant and Sushi Bar in downtown Clemson.

BY LIISA KUHN, GUEST EDITOR, SFB IMMEDIATE PAST PRESIDENT



3D Bioprinting: Fundamentals, Principles and Applications, Ibrahim T. Ozbolat, Elsevier Inc., 2016; 356 pp. ISBN: 978-0-12-803010-3

The field of 3D printing for medicine continues to rapidly expand, but a recent search on Amazon.com reveals that there are still only a handful of textbooks available on the subject. 3D printing is also known by other terms, such as additive manufacturing, rapid prototyping, solid free-form fabrication or layered manufacturing. The subset of 3D printing known as bioprinting can be defined as a computer-aided manufacturing process for simultaneous writing of living cells and biomaterials with a prescribed layer-by-layer stacking organization to fabricate bioengineered constructs for tissue engineering, regenerative medicine or other biological studies. Notably, *3D Bioprinting* is focused distinctively on bioprinting and is written entirely by one of the leaders in the field, rather than being an edited compilation.

This book should be highly useful for those in the emerging bioprinting industry as well as those in academic and educational circles and the general public. After reading this book, students, bioengineers, tissue and manufacturing engineers and medical doctors will be able to understand features of various bioprinting processes, bioinks and bioprinter types — and how to select the appropriate process for a given application, such as tissue engineering and regenerative medicine, transplantation, clinics or pharmaceuticals. It is a great textbook for upper undergraduate- and graduate-level courses on bioprinting and biofabrication, or supplement for a course on tissue engineering. Because it is written by a single author, the content is cohesive and well-written and flows easily from chapter to chapter.

The book is outlined in 10 chapters: Introduction, Design for Bioprinting, The Bioink, Extrusion-Based Bioprinting, Droplet-Based Bioprinting, Laser-Based Bioprinting, Bioprinter Technologies, Roadmap to Organ Printing, Applications of 3D Bioprinting, and Future Trends.

Chapter 1 introduces 3D printing in tissue engineering, principles of bioprinting, bioprinting components, and historical evaluation and classification of bioprinting processes.

Chapter 2 discusses design for bioprinting and covers the entire range of steps taken from medical imaging to bioprinting.

Chapter 3 covers the materials that bioinks are made from, scaffold-free bioink materials (e.g., cell aggregates, compatible bioprinting techniques) and a comparison of bioink types.

Chapters 4–6 describe the three major groups of bioprinting modalities: extrusion-, droplet- and laser-based bioprinting. In each modality, the process, its characteristics and main components are described, including the underlying physics and suitable bioink and cell types amenable to printing.

In Chapter 7, commercially available bioprinters are reviewed, and there is a detailed discussion on the limitations of particular technologies.

Chapter 8 covers organ printing and introduces the state-of-the-art, followed by a road map for organ printing with a step-by-step description of the path from individual cells to whole organs.

Chapter 9 presents the medical application areas of bioprinting, including tissue engineering and regenerative medicine, clinics and transplantation, pharmaceuticals and cancer research.

Finally, Chapter 10 discusses the future trends in bioprinting that are anticipated to revolutionize organ transplantation technology, including bioprinting of DNA for gene delivery and regulatory concerns.

As someone ready to embark on a visiting professorship at an international organization specializing in bioprinting, I needed to read some background material about bioprinting, and I found this book to be very helpful. I was pleased to have the extensive set of references for each chapter summarized concisely. I enjoyed the quotes from a variety of authors that precede each chapter. Many original colored figures beautifully illustrate complex subtopics. In this day and age where marketing of scientific technologies is sometimes taken to an extreme, it was refreshing to read about disadvantages as well as advantages of bioprinting. When I needed information on a particular subtopic such as hydrogels used in bioprinting, I found the information easily in table form that contrasted advantages and disadvantages of a wide variety of materials. Images for sample tissue constructs were shown in the table as well. This is an example of how Ozbolat has gone above and beyond to make this textbook a valuable investment.

Call for Student / Trainee Award Nominations



Nomination deadline:
September 15, 2017

Required Supplemental Documents:

- Resumé / CV
- [Certification of Status Form](#) (Due Sept. 16, 2017)
- Manuscript (Due Oct. 16, 2017)
- Abstract of Manuscript submitted to SFB Annual Meeting (Due Oct. 16, 2017)
- Three Supporting Letters of Recommendation (Due Sept. 16, 2017)

Award recipients receive:

- Certification of Award
- Travel support up to \$500 for the SFB Annual Meeting in Atlanta, GA
- Consideration for publication of paper in Journal of Biomedical Materials Research or Applied Biomaterials
- Complimentary meeting registration

NOTE: Manuscripts and abstracts for the Outstanding Research Awards (Student and Intern) will be accepted until October 16, 2017



Society For Biomaterials
Giving life to a world of materials

SFB is accepting nominations for Student Awards!

[Student Awards for Outstanding Research](#)

Student researchers who have shown outstanding achievement in biomaterials research may submit applications and a manuscript reporting their research. The manuscript must be in the style of Journal of Biomedical Materials Research and must be submitted in one of the following categories:

- Undergraduate student
- Masters or Health Science degree
- Ph.D. degree candidate or equivalent

[Outstanding Research by a Hospital Intern, Resident or Clinical Fellow Award](#)

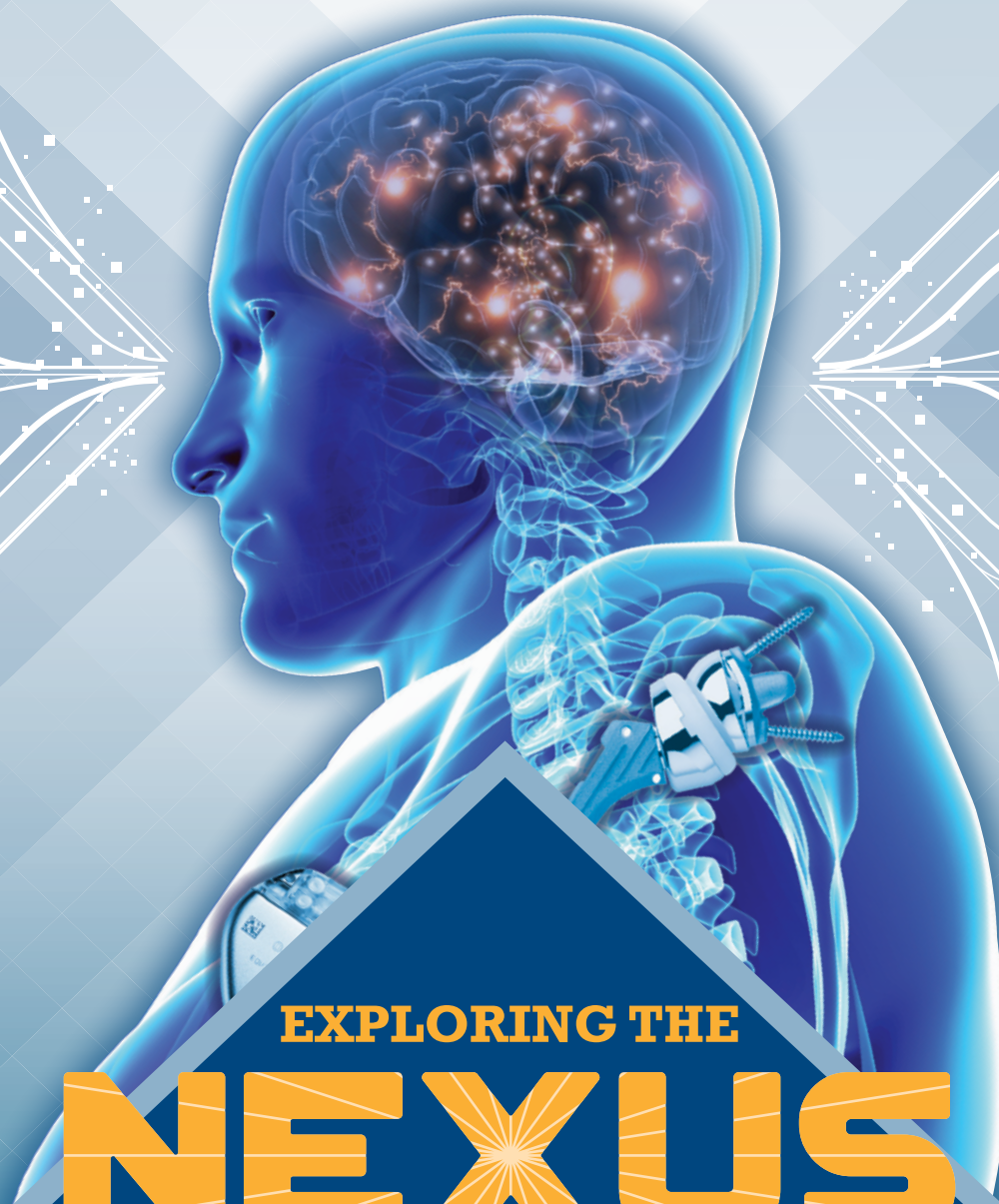
Hospital interns, residents, clinical fellows, or individuals in equivalent positions who have shown outstanding achievement in biomaterials will be considered for this award. Applicants may have already completed their program. In such cases, submitted papers must be the result of the research conducted during their internship, residency or fellowship. The manuscript must be in the style of Journal of Biomedical Materials Research.

For the [Nomination Form](#) you can visit the SFB website at:

<http://biomaterials.org/awards/awards-descriptions>

SOCIETY FOR BIOMATERIALS 2018 ANNUAL MEETING & EXPOSITION

April 11-14, 2018 • Hilton Atlanta • Atlanta, GA



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