IN THEIR OWN WORDS — 2017 CATO T. LAURENCIN TRAVEL FELLOWSHIP WINNERS

UPDATES FROM THE CARDIOVASCULAR AND NANO SIGS

BIOMATERIALS FORUM

OFFICIAL NEWSLETTER OF THE SOCIETY FOR BIOMATERIALS

THIRD QUARTER 2017 • VOLUME 39, ISSUE 3

ALSO INSIDE

AN INTERVIEW WITH ANKUR SINGH, 2017 YOUNG INVESTIGATOR AWARDEE

MEMBER NEWS THAT MAKES US PROUD

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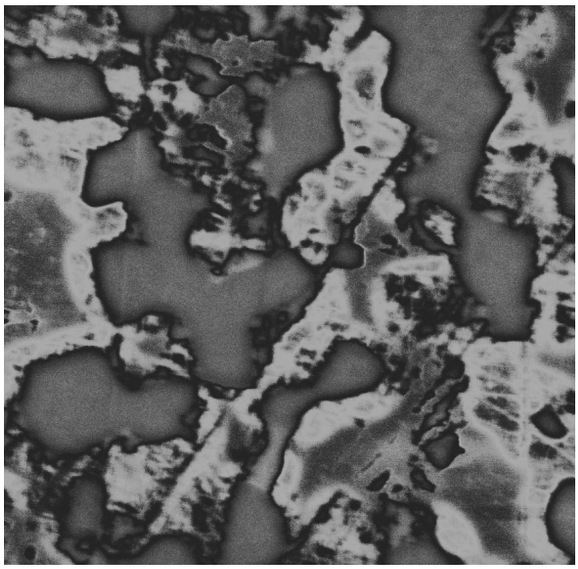
BIOMATERIALS FORUM

The official news magazine of the **SOCIETY FOR BIOMATERIALS** • Volume 39, Issue 3

SPECIAL INTEREST GROUP REPORTERS



ON THE COVER

The cover image, provided by Hetal Maharaja of the research group of Prof. Guigen Zhang at Clemson University, shows an SEM image (pseudo-colored for visual effect) of an alumina-titanium carbide ceramic composite. Though the material is regarded as having excellent hardness and mechanical strength, this image shows microscale damage on the surface of the composite under a combined gentle abrasive and electrochemical process.

Contents

THE TORCH

NEWS & UPDATES

From the Editor

CULTURE IS WHAT MATTERS!

Guigen Zhang

A recent book review in *The Wall Street Journal* (July 22, 2017) by David Barash brought my attention to the book *Darwin's Unfinished Symphony: How Culture Made the Human Mind* by Kevin N. Laland. In the book, Laland asks if culture is most fundamental to our humanity. To put this question in perspective, Laland asserts that we used to believe that the ability to make tools set humans apart from animals. But, we now know that many animals also possess the ability to make — not just use — tools to find food. Cases in point: Mariana crows can assess a problem involving out-of-reach food, then construct — yes, actually build — a tool to access it. Chimpanzees can decide which members of their troop to release from a cage to help obtain a reward based on their prior knowledge of who is most likely to share the bounty with the others. These facts suggest that there must be something beyond tool making and use. Laland's thesis argues that humans thrive because of their ability to copy and teach (a "high-fidelity information transmission" process) and from the ways humans adapt and even bring on evolution.

This is the kind of culture the author is talking about. In Laland's view, cultural innovations are not just mere human responses to environmental challenges but proactive means to create suitable surroundings within which natural selection made us what we are today.

I think this cultural thesis has vast implications to many things, including the thriving of our professional society — the Society For Biomaterials — and even our institutions. When we ask why members keep coming back to Annual Meetings, it's the SFB culture that they value most. In his From the President column, David Kohn talks about "building" and creating up-to-date cultural surroundings on the SFB foundation. Such efforts surely will prepare SFB to thrive in the natural selection process for the survival of professional societies.

Take a hint from this: For our academic institutions, cultivating cultures that unleash people's imaginative energy and creative power and that feed back into institutions' evolutions should be fundamental to the advancement of any institutions, too!

Then comes naturally the question, What constitutes such a culture? Obviously, this is a big, open-ended question to which we each have our own answer. Hence, my intent here is not to provide an answer but to initiate discussions such that SFB's cultural building efforts will play a bigger role in advancing our academic institutions and our humanity.

In closing, let me briefly tell you what we have prepared for you in this issue. In From the President, David Kohn shares with us numerous building efforts and initiatives that the leadership team has planned and embarked on to advance SFB in the years to come. In Members in the News, prepared by member-at-large Helen Lu, you will read about exciting news and accomplishments from our members. I am certain that reading the news will make you proud to be an SFB member!

You will also catch up with staff updates and student chapter updates and read In Their Own Words feedback from the three 2017 Cato T. Laurencin Travel Fellowship winners. In the SIG section, you will read updates from the Cardiovascular Biomaterials SIG and the Nanomaterials SIG. In our regular columns, you will find latest industry news from Steve Lin; government news from Carl Simon; and a book review on ASTM standards and publications by Lynne Jones, Liisa Kuhn, Jack Lemons and Barbara Boyan. In addition, you will read a brief greeting message from our new SIG representative, Sarah Stabenfeldt, and see a snapshot photo of Allan Hoffman (accompanied by Kristi Anseth and Art Coury) receiving the Acta Biomaterialia Gold Medal Award during the 2017 SFB Annual Meeting.

Lastly, we have prepared for you an interview with the SFB 2017 Young Investigator Award winner, Ankur Singh, for a close-up of another SFB rising star who is successfully balancing life and work.

Best wishes,

Guigen Zhang

Book Review

AN IMPORTANT RESOURCE: ASTM STANDARDS AND PUBLICATIONS

By Lynne Jones, Liisa Kuhn, Jack Lemons and Barbara Boyan

Founded in 1898, the American Society for Testing and Materials (ASTM; astm.org) develops and publishes technical standards for a wide range of materials, products, systems and services. This includes all products from A (aerospace) to T (transportation). There are 22 technical committees; Committee F04 is the technical committee for medical and surgical materials and devices. F04 has 34 technical subcommittees that maintain jurisdiction over medical product standards. Several of our SFB members are actively involved in F04.

ASTM publishes more than 12,000 ASTM standards and more than 52,000 journal papers and book chapters in its digital library. A major resource is the *Annual Book of ASTM Standards*, available in print and online formats. F04, with a membership of approximately 900, currently has jurisdiction of more than 305 standards, published in the *Annual Book of ASTM Standards, Volumes 13.01 and 13.02*. Standards are written about topics relating to metals, polymers and ceramics for implants, prostheses and medical and surgical devices; silicone elastomers, gels and foams in medical applications; and tissue-engineered medical products, including preclinical testing, cells and growth factors. Standards also are developed, which encompass manufacture, chemical requirements, mechanical requirements, special tests and certification. There are various types of standards, including standard terminology, specifications, test methods, guides and practices.

The standards are immensely valuable to SFB members, whether members are evaluating a new or old material, testing a material in isolation, or testing a material's effect on cells, tissues or whole-body physiology. Standardized test methods and specifications set a bar for minimal requirements that a manufacturing company must meet, but they also provide useful information for academic research and development. Guidance documents provide generalized information about a biomaterial or test method and identify areas of importance. Examples of guides include *ASTM F2942-13 Standard Guide for in vitro Axial, Bending, and Torsional Durability Testing of Vascular Stents*; *ASTM F2903-11 Standard Guide for Tissue Engineered Medical Products (TEMPs) for Reinforcement of Tendon and Ligament Surgical Repair*; *ASTM F2888-13 Standard Test Method for Platelet Leukocyte Count — An In-Vitro Measure for Hemocompatibility Assessment of Cardiovascular Materials*; and *ASTM F2003-02(2015) Standard Practice for Accelerated Aging of Ultra-High Molecular Weight Polyethylene after Gamma Irradiation in Air*.

ASTM also publishes books that are a collection of publications from its workshops. Three examples that are useful in musculoskeletal research are:

- *MONO6-2ND*
  Bone Graft Substitutes and Bone Regenerative Engineering, 2nd ed.
  Laurencin Cato, Jiang Tao
  Published: 2014
  ISBN 978-0-8031-7060-5
- *STP1591*
  Modularity and Tapers in Total Joint Replacement Devices
  A. Greenwald, Steven Kurtz, Jack Lemons, William Mihalko
  Published: December 2015
  ISBN 978-0-8031-7627-0
- *STP1560*
  Metal-On-Metal Total Hip Replacement Devices
  Steven Kurtz, A. Greenwald, William Mihalko, Jack Lemons
  Published: 2013
  ISBN-EB: 978-0-8031-7572-3

We encourage you to become an ASTM member. The development of standards that influence our current and future medical implants is dependent on individuals such as yourself. Standards development is a rigorous, consensus-based process, yet task force participation does not require in-person travel to the twice-yearly committee meetings and is often conducted solely via webinar. The process is dependent on individuals from all disciplines with the technical expertise concerning biomaterials development, characterization and use.

Further membership information can be found at astm.org/membership/index.html or by contacting Liisa Kuhn, SFB immediate past-president and Subcommittee F04.42 chair, or Barbara Boyan, Subcommittee F04.44 co-chair and member of Committee F42 on additive manufacturing.

From the President

IF YOU BUILD IT, HE WILL COME

David Kohn

I hope you enjoyed your summer and found time to relax.

Summer is baseball season, and the title of my letter is a quote from the baseball movie *Field of Dreams*. In my first letter, I described my vision for the Society and plans for this year. In this second letter, I want to provide an update on what SFB is "building."

Since my last communication, all committee and task force chairs have been named, and chairs have populated their committees and task forces with more than 60 volunteers (thank you to everyone for dedicating your time!). Each committee has developed an agenda for the year and has had at least one conference call, and most chairs have attended the summer council meeting/strategic planning session. Several initiatives within the Society's strategic plan are underway, but we are not building from scratch. The building started in 1969 when the First International Biomaterials Symposium (the precursor to the Society For Biomaterials Annual Meeting) was held at Clemson University. This was also the year I became interested in baseball, giving the theme of this letter even more meaning to me.

What we want to "build" in the hopes that (s)he will "come" is less actual building and more branding and broadcasting of what has already been built. A key aspect is to communicate three important messages: biomaterials is a unique discipline; SFB intimately understands and embraces all aspects of this unique discipline, offering members a unique proposition; and SFB is committed to training and developing the careers of the next generation of people who practice this unique discipline. Communication and branding are being achieved by integrating the efforts of many committees, in particular a new Web and Social Media Task Force working in concert with the Membership Committee and the Education & Professional Development (E&PD) Committee.

As a key component of the visibility and PR domain of the strategic plan, we have expanded the role of the web editor (Adam Ekenseair) and created a more comprehensive Web and Social Media Task Force (Tom Dziubla, chair) to guide an electronic visibility strategy. Keep your eye out for increased information about the Society and individual members disseminated via social media. (We have already had a four-fold increase in Facebook followers since the campaign started.)

News items will be more rapidly disseminated via social media to communicate news closer to in real time. Shortly, we will also launch a Faces of SFB campaign in which individual members will be highlighted on the website.

Rather than working as an isolated committee, the Membership Committee (Christopher Gehrmann, chair) will integrate with the Web and Social Media Task Force and the E&PD Committee to better communicate the value of membership. Building on last year's PR initiatives to increase the visibility of the Society and its members, a goal this year is to target specific groups for conversion to membership. At the core of this initiative is defining the unique skills of a biomaterialist and how SFB is best suited to support the education and development of people in the field. In collaboration with the Web and Social Media Task Force, promotional videos are being developed on what being a member of SFB has done for people personally and professionally (anyone who would like to be in a video, please let me know!).

Recruiting members is just a first step; we must make the Society attractive for members to stay. There is a correlation between member engagement and retention. SFB is excellent at recognizing young members and senior members. To better recognize members in the middle tier, the Awards, Ceremonies and Nominations Committee (Nick Ziats, chair) has developed a new award — a Mid-Career Award modeled after the Young Investigator Award intended to recognize mid-level members.

Please be on the lookout for a call to be a mentor or mentee. The E&PD Committee (Jan Stegemann, chair) has compiled a menu of activities. Mentees will select which item(s) they would like mentoring on. Likewise, mentors will select which activities they are willing to participate in, and mentor/mentee relationships will be established.

Planning for the 2018 Annual Meeting (April 11 – 14, 2018, in Atlanta) is well underway. More than 100 ideas were submitted, and 70 have been selected to submit proposals. The theme of the meeting is exploring the nexus of research and application. The motivation for this theme is that both SFB and the city of Atlanta serve as connectors. SFB provides a unique blend of industry and academia, basic and applied research, and materials and biology, while Atlanta serves as a connector to the world. Thus, a goal of the 2018 Annual Meeting is to connect the world of biomaterials.

A new career catalysis track has been created for the 2018 meeting. This track, spearheaded by Jan Stegemann and Cole DeForest (Young Scientist Group), represents a consolidation of workshops, panel discussions, tutorials, symposia and student activities geared toward career development under a common banner that permeates the whole program. In addition to the Biomaterials Education Challenge, there will be sessions on grant writing, a symposium on skill sets for industry, a return of the

cage match debating academia vs industry (where can you have the greatest impact?) and a symposium honoring the editors of *Biomaterials Science*. The abstract deadline is Oct. 23, 2017, so please be on the lookout for the call for abstracts starting in late August.

Within the strategic domain of globalization, the Liaison Committee (Tim Topoleski, chair) has developed a formal process for approaching new societies and how to serve as a clearinghouse to make connections with biomaterials groups around the world. In 2018, Liisa Kuhn is spearheading a joint SFB/ESB summer school in France. Please encourage your students to apply for scholarships, and if anyone is interested in participating in sessions related to 3DP, please let Liisa know. Discussions on how to best engage with the Scandinavian, Korean and Japanese societies have also been fruitful.

Hopefully, I have been able to convey some what is being "built" and how we are enticing people to "come." As always, please feel free to contact me (dhkohn@umich.edu) if you have any questions, thoughts or concerns about our Society.

Members in the News

NEWS & UPDATES

By Helen H. Lu, Member-at-Large

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

Please see below for this quarter's exciting member news and accomplishments.

MEMBER NEWS

Danielle Benoit, associate professor of biomedical engineering at the University of Rochester, is the recipient of the Young Engineer of the Year Award from the Rochester Engineering Society. The award recognizes outstanding achievement in and contributions to the profession by young engineers in the Rochester region. Read more at hajim.rochester.edu/news/2017-04-07_benoit_resaward.html.

Rao Bezwada, president of Bezwada Biomedical, writes that Bezwada Biomedical licensed its proprietary adhesive technology to Abyrx Inc. for soft tissue applications. Both Bezwada and Abyrx believe that they have a significant opportunity to address the limitations of other marketed products for soft tissue hemostasis, sealing and fixation because of the high rate of reactivity and unique tunability of Bezwada's polymer technology. Abyrx raised $10 million in new equity for the development and production of Bezwada's soft tissue adhesive technology. Read more at massdevice.com/abyrx-raises-10m-inks-soft-tissue-adhesive-deal-bezwada-biomedical.

Susmita Bose, the Herman and Brita Lindholm Endowed Chair Professor at the School of Mechanical and Materials Engineering at Washington State University, has been elected a Fellow of the American Association for the Advancement of Science in recognition of her significant contribution to the development of advanced biomaterials and education of the next generation of material scientists. Dr. Bose also received the 2016 International Society for Ceramics in Medicine Research Excellence Award. Read more at news.wsu.edu/2016/11/22/four-wsu-faculty-elected-to-aaas.

Jim Burns, former SFB president, is now the CEO of Casebia Therapeutics, a joint venture between CRISPR Therapeutics and Bayer. Read more at businesswire.com/news/home/20161101005484/en/Casebia-Therapeutics-Announces-Appointment-James-W.-Burns.

David Castner, professor of bioengineering and chemical engineering and director of the National ESCA and Surface Analysis Center for Biomedical Problems at the University of Washington, has received the 2017 European Conference

on Applications of Surface and Interface Analysis Award in recognition of his outstanding scientific achievements in the field of surface and interface analysis. Read more at bioe.uw.edu/david-castner-receives-2017-european-conference-on-applications-of-surface-and-interface-analysis-award and ecasia2017.com/ECASIA-2017-Award.

Eno Ebong, assistant professor of chemical engineering at Northeastern University, was honored with a National Institutes of Health (NIH) Mentored Research Scientist Career Development Award based on her novel research on mechanotransduction mechanisms of glycocalyx related to cardiovascular health. Read more at che.neu.edu/news/ebong-receives-prestigious-nih-award#_ga=2.50611817.1300543492.1500054902-1648613032.1500054902.

Ahmed El-Ghannam, associate professor of tissue engineering and biomaterials at the University at North Carolina at Charlotte, will be organizing and chairing the 34th Southern Biomedical Engineering Conference from March 8 to 10, 2018, in Charlotte, North Carolina.

Jennifer Elisseeff, Morton Goldberg Professor and director of the Translational Tissue Engineering Center at the Wilmer Eye Institute and the Department of Biomedical Engineering at Johns Hopkins University, was featured in *Hopkins Medicine* in a cover story on her group's discovery of the importance of biomaterial-immune cell interactions in tissue regeneration and renewal. Read more at hopkinsmedicine.org/news/publications/hopkins_medicine_magazine/features/spring-summer-2017/renewed.

Andrés García, the Rae S. and Frank H. Neely Endowed Chair and Regents' Professor in the Woodruff School of Mechanical Engineering and the Petit Institute for Bioengineering and Bioscience at the Georgia Institute of Technology, has won the Juvenile Diabetes Research Foundation Georgia Chapter's Research to Reality Leadership Award. This award honors Dr. García's pioneering work in the development of synthetic hydrogels for beta cell encapsulation. Read more at jdrf.org/georgia/2017/07/12/dr-andres-j-garcia-georgia-tech-receives-jdrf-research-to-reality-award.

Zach Hilt, the William Bryan Professor of Chemical and Materials Engineering at the University of Kentucky, has been appointed the Gill Eminent Professor of Chemical Engineering in recognition of his innovative research in biomaterials and bionanotechnology.

Christopher Jewell has been promoted to associate professor with tenure at the University of Maryland. In addition, the Jewell Lab in the Department of Bioengineering began a four-year project funded by the U.S. Department of Veterans Affairs using self-assembly to study and combat autoimmune disease in mouse models of multiple sclerosis and in samples from human multiple sclerosis patients.

Jeff Karp, associate professor of medicine at Harvard Medical School, and his lab at Brigham and Women's Hospital were featured in a WGBH radio Innovation Hub piece about his inventions, reverence for evolution and biomimetic vision. Read more at blogs.wgbh.org/innovation-hub/2017/7/6/what-nature-can-teach-science.

Liisa Kuhn, immediate past-president of SFB and associate professor of biomedical engineering at the University of Connecticut (kuhnbiomaterials.org), was a visiting professor at the University of Bordeaux (INSERM U1026 Bioingénierie tissular BioTis), France, for the month of June 2017. The AMADEus Advanced Materials by Design program sponsored her visit.

Kyle Lampe, assistant professor of chemical engineering at the University of Virginia, has been named an inaugural Translational Health Research Institute of Virginia Scholar. This mentored career development award will enable Dr. Lampe to translate his novel engineered protein hydrogels to stroke applications. Read more at thriv.virginia.edu/thriv-scholars-named.

Cato Laurencin, university professor at the University of Connecticut and CEO of the Connecticut Institute for Clinical and Translational Science, has been elected a Foreign Fellow by the Indian National Academy of Engineering in honor of his outstanding accomplishments bridging engineering and medicine. Read more at aimbe.org/indian-national-academy-of-engineering-elects-dr-laurencin.

Tony Mikos, Louis Calder Professor of Bioengineering and Chemical and Biomolecular Engineering at Rice University, was inducted to the Academy of Athens on March 14, 2017. Dr. Mikos is recognized as "a global pioneer in the application of fundamentals of engineering and biological sciences toward the development of biomaterials for a wide variety of medical uses." Read more at engineering.rice.edu/news/mikos-elected-academy-athens.

Samir Mitragotri has recently relocated to Boston and is currently the Hiller Professor of Bioengineering and Wyss Professor of Biologically Inspired Engineering at Harvard University. Read more at seas.harvard.edu/news/2017/01/renowned-bioengineer-to-join-harvard-faculty. Dr. Mitragotri is also the treasurer-elect for the Controlled Release Society (CRS).

Nicholas Peppas, Cockrell Family Regents Chair in Engineering at the University of Texas at Austin and a pioneer in oral drug

delivery systems, was elected a member of the American Academy of Arts and Sciences. (Read more at news.utexas.edu/2017/04/13/peppas-elected-to-the-american-academy-of-arts-and-sciences.) In addition, both he and **Robert Langer**, David H. Koch Institute Professor at MIT, were named in the first five researchers of the Medicine Maker's Power List 2017. (Read more at themedicinemaker.com/power-list/2017.)

Dr. Peppas has also received the inaugural Pioneer of Nanomedicine Award from Johns Hopkins University, honoring his interdisciplinary work that has had a tremendous impact on societal health. (Read more at che.utexas.edu/2017/02/20/pioneer-of-nanomedicine.) In addition, in recognition of his exceptional commitment and service, Dr. Peppas received the CRS Distinguished Service Award. (Read more at controlledreleasesociety.org/about/Awards/Pages/DistinguishedService.aspx.)

Rui Reis, full professor of tissue engineering, regenerative medicine, biomaterials and stem cells at the Department of Polymer Engineering, director of 3B's Research Group and vice-rector for research of the University of Minho in Portugal, has received the TERMIS-EU Award for Contributions to the Literature in recognition of his outstanding work in biomaterials and tissue engineering. Read more at gmrtv.pt/educacao/31411-uminho-professor-rui-reis-recebeu-premio-europeu-termis-eu.

Jeff Sakamoto recently moved from Michigan State University to the University of Michigan. As an associate professor in the Department of Mechanical Engineering at Michigan, Dr. Sakamoto will continue to expand his research program, with an emphasis on the manufacturing of biomedical implants and designing materials for energy technologies. Read more at me.engin.umich.edu/people/faculty/jeff-sakamoto.

Mark Saltzman, Goizueta Foundation Professor of Biomedical Engineering, Chemical, and Environmental Engineering and Physiology at Yale University, has received the CRS Founders Award in recognition of his seminal contributions in the science and technology of controlled release. Read more at controlledreleasesociety.org/about/Awards/Pages/FoundersAward.aspx.

Anirban Sen Gupta, associate professor of biomedical engineering at Case Western Reserve University, has received a $1 million grant from the U.S. Department of Defense (DoD) Medical Research and Development Program to evaluate platelet-inspired biomaterials technologies for hemorrhage control and wound healing in large animal (pig) polytrauma and burn injury models. Dr. Sen Gupta and his lead researcher, **Christa Pawlowski** (past National Science Foundation Graduate Research Fellowship Program Fellow and past president of Case Western's SFB chapter), have also co-founded a company, Haima Therapeutics LLC, with a vision for translation and commercialization of platelet-inspired technologies. The company holds two issued patents and three pending patents in this area.

Furthermore, **Dr. Sen Gupta**, **Michael Suster** and **Pedram Mohseni** (principal investigator and co-investigator, respectively, from Case Western) have received a research grant from the American Heart Association (AHA) to develop and evaluate a miniaturized dielectric coagulometry sensor (termed "ClotChip") for engineering a handheld, point-of-care device for comprehensive assessment of platelet dysregulation and coagulatory dysfunction using a very small volume (~10 uL) of blood. The device can help early assessment of drug- or trauma-induced clotting disorders.

Ankur Singh, assistant professor of mechanical and aerospace engineering at Cornell University, has received a three-year Career Development Award from DoD through its Peer-Reviewed Cancer Research Program to study diffuse large B-cell lymphoma.

Ming Su, associate professor of chemical engineering at Northeastern University, was invited to present his research on "Single cell based DNA damage assay for space radiation research" at the 5th International Symposium on Space Radiation and Particle Radiotherapy. Read more at che.neu.edu/news/su-presents-research-issrprt-2017.

Susan Thomas, assistant professor of mechanical engineering at the Georgia Institute of Technology, has begun a three-year Career Development Award from DoD through its Peer-Reviewed Cancer Research Program to explore targeted therapies for melanoma. Her group also began two five-year grants from NIH's National Cancer Institute developing drug delivery strategies for immunotherapy and exploring tumor microenvironment effects on the immune system in melanoma.

Tom Webster, Art Zafiropoulo Chair and professor and chair of the Department of Chemical Engineering at Northeastern University, was featured on the National Geographic special "Year Million," in which he spoke about nanotechnology and what biomaterials will look like in the future. (Read more at channel.nationalgeographic.com/year-million.) In addition, Dr. Webster was honored at a U.S.-China signing ceremony on May 27, 2017, in Boston. This was part of the Zhejiang and Overseas High-level Talents Conference, which focuses on recruiting overseas experts and talents. Last year, Zhejiang introduced more than 1.6 million overseas high-level personnel into this special program. (Read more at che.neu.edu/news/tom-webster-honored-zhejiang-and-overseas-high-level-talents-conference.)

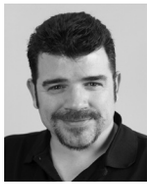
Xiaoming Xu, Jack Sheridan Endowed Professor and head of the Division of Biomaterials at Louisiana State University Health New Orleans School of Dentistry, is the recipient of a $2.46 million grant from NIH for his project titled "High Performance Antibacterial Fluoride-releasing Dental Materials." Read more at lsusd.lsuhsc.edu/News/XuGrant-ResearchDay2017.html.

STUDENT NEWS

DaShawn Hickman, a medical scientist training program researcher in **Dr. Sen Gupta**'s team at Case Western Reserve University, has received a pre-doctoral fellowship from AHA to study targeted drug delivery technologies in trauma treatment.

Staff Update

By Dan Lemyre, Executive Director, CAE



Hello from Society For Biomaterials Headquarters! SFB's Governing Council held a strategic planning meeting on July 18, 2017. As the new program year gets underway, the Society's Board of Directors, Governing Council, committees, task forces and SIGs will be working to advance the Society's strategic plan. (A PowerPoint summary of the strategic plan is available under the About menu of biomaterials.org.) A summary of the strategic initiatives being pursued follows.

AWARDS, CEREMONIES AND NOMINATIONS COMMITTEE

Chair: Nicholas Ziats, PhD

The Awards, Ceremonies and Nominations Committee is soliciting nominations for a new award this year. A Mid-Career Award has been created to increase recognition for those between the Young Investigator Award and Major/Clemson Award brackets. Modeled after the Young Investigator Award, this new award seeks to recognize excellence in research by those who are more than 10 years and less than 20 years beyond receipt of their terminal degree. The awardee will be selected from formal nominations submitted and a manuscript in the style of the *Journal of Biomedical Materials Research*. (The manuscript may be an expert opinion, perspective, topical review or a historical piece. Manuscripts not strictly focused on research are intended to encourage industry and regulatory candidacy.) The Awards, Ceremonies and Nominations Committee is also taking over responsibility for the C. William Hall Scholarship and the Cato T. Laurencin Travel Fellowship programs.

EDUCATION & PROFESSIONAL DEVELOPMENT COMMITTEE

Chair: Jan Stegemann, PhD

The Education & Professional Development Committee is working with the Young Scientist Group and the Program Committee to incorporate a career catalysis track in the 2018 Annual Meeting program. This track will include content for students, postdocs and young members in industry and academia to help guide them in their career development. The committee is also working to operationalize a long-planned mentorship program that seeks to match senior SFB members with junior SFB members looking for career advice, help with grants, and guidance for intellectual property issues, research translation and regulatory issues. Be on the lookout for opportunities to volunteer as a mentor or to request a mentor in the near future! If you are just starting out in your career (less than 10 years from terminal degree) and want to be part of the Young Scientist Group, please contact SFB at info@biomaterials.org.

FINANCE COMMITTEE

Chair: Elizabeth Cosgriff-Hernandez, PhD

SFB is preparing the 2018 budget to return the Society to positive net income. After three years of an intentional operating deficit to allow the Society to invest resources back into its membership, it does not appear that the Society will return to an operational net income in 2017. Please help the Society by booking your accommodations for the Annual Meeting at the headquarters hotel. In 2018, the entire meeting, all events and exhibits (except for the SFB Bash) will take place at the Hilton Atlanta.

LIAISON COMMITTEE

Chair: Tim Topoleski, PhD

The Liaison Committee will be evaluating event endorsement requests going forward and will be working with a few organizations on collaborative programming. These include possible sessions for the 2018 Annual Meeting (the Korean Society for Biomaterials and the American Society for Matrix Biology) and a possible Fall Symposium in 2020 with the Japanese Society for Biomaterials.

MEMBERSHIP COMMITTEE

Chair: Christopher Gehrmann, PhD

Current membership stands at 1,161, which is up from last

Staff Update [continued]

year. We will be launching a new Faces of SFB campaign in the coming months to generate visibility online, and we're executing a membership recruitment campaign to former members and other prospects in our database. We hope to expand membership in 2018 and provide all members with more access to contacts in the biomaterials field. We know that networking is a key benefit of membership, and we want to provide the largest network possible while keeping it relevant to the field. Headquarters staff are also working to make the join and renewal processes easier to navigate and more efficient.

PROGRAM COMMITTEE

Chairs: Bob Hastings, PhD, and Johnna Temenoff, PhD

The 2018 SFB Annual Meeting will take place in Atlanta, Georgia, from April 11 to 14. The call for abstracts will be distributed in late August, and the 2018 website and abstract submission portal will also open at this time. To address a recent surge in no-show abstract submissions and help defray the expenses associated with abstract processing, the Society will charge $25 per abstract submission before the Oct. 23 deadline. Abstracts submitted between Oct. 24 and Nov. 1 will be subject to a $50 submission fee. All authors who submit at least one abstract to the 2018 Annual Meeting will be given a $25 credit on Annual Meeting registration. The meeting will include a new career catalysis track, and two session formats from the 2017 Annual Meeting are being revisited: the Thought Leader Symposia and the Biomaterials Technology in Industry sessions.

PUBLICATIONS COMMITTEE

Chair: Sachin Mamidwar, MBBS, MS

At the direction of Council, the Publications Committee is exploring an all-electronic *Biomaterials Forum* and a hybrid option with a more robust electronic version with the print version. This decision will be driven by both cost estimates and membership data and usage surveys. The Publications Committee is also working with Wiley to address policy issues around preprints and data, and the Committee is also working with the textbook editors on a plan to craft the next edition of *Biomaterials Science*.

NATIONAL STUDENT SECTION

President: Daniel Hachim

The National Student Section is preparing for the Biomaterials Day grant deadline (Sept. 16)! Currently, there are 29 student chapters at universities across the country, a record high! As 2018 budget preparation continues, the National Student Section will be planning activities for the 2018 Annual Meeting and discussing ways to invigorate local chapters.

SIGs

Representative: Sarah Stabenfeldt, PhD

The 2018 Program Committee has requested that SIGs play a more active role in session development for the 2018 Annual Meeting. In many cases, this means that abstracts should be submitted to the general SIG sessions for evaluation, and each SIG will have the ability to form a session(s) from its submitted abstracts.

WEB AND SOCIAL MEDIA TASK FORCE

Chair: Tom Dzuibla, PhD

A new task force — the Web and Social Media Task Force — has been established to help generate more SFB buzz on social media. Going forward, all members of the task force will be able to post to the Society's Twitter feed and Facebook wall. To ensure transparency, each post will be marked with the initials of the author. For example, "SFB early bird abstract deadline 10/23! /dl" would be a post from Dan Lemyre. Be sure to like our Facebook page and follow SFB on Twitter! @SFBiomaterials

FELLOWS TASK FORCE

Chair: Brendan Harley, ScD

With the FBSE designation at capacity within the Society's ranks (College of Fellows bylaws restrict this designation to 10 percent of the Society's total membership), the Society is considering a distinct SFB Fellow designation that would allow SFB to recognize as many contributors to the Society as it pleases. While this is by no means a fait accompli, the idea is gaining traction, so please don't hesitate to make your opinions on the matter known.

If you have any questions,

need any information or have suggestions for improved services, please feel free to contact the Society's Headquarters office:

SOCIETY FOR BIOMATERIALS
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Student Chapter Update

GREETINGS FROM THE NATIONAL STUDENT SECTION

By Daniel Hachim, National Student Section President

It is an honor to serve as student president of the Society For Biomaterials and represent the interests of all students in the biomaterials community. National Student Section members Margaret Fettis (president-elect), Rahim Jindani (secretary/treasurer), Marc Thompson (secretary/treasurer-elect) and Leslie Pace (bylaws chair) are actively involved with many of the Society's activities to enhance the student experience.

We also would like to introduce the student representatives proudly serving student interests in each SIG:

Margaret Fettis (University of Florida) — Biomaterials Education
Lee Zhen (University of Washington) — Biomaterial–Tissue Interaction
Travis Prest (University of Pittsburgh) — Biomaterials and Medical Products Commercialization
Jaci Bliley (Carnegie Mellon University) — Cardiovascular Biomaterials
Daniel Hachim (University of Pittsburgh) — Drug Delivery
Michaela Mertz (University of Florida) — Engineering Cells and Their Microenvironments
Yaoying Wu (Duke University) — Immune Engineering
Lukas Farbiak (University of Texas Southwestern) — Nanomaterials
Maryam Ali (University of Texas at Austin) — Ophthalmic Biomaterials
Yuchen Wang (University of Rochester) — Orthopaedic Biomaterials
Rafael Ramos (Syracuse University) — Protein and Cells at Interfaces
Bethany Almeida (Brown University) — Surface Characterization and Modification
Bhuvaneswari Gurumurthy (University of Mississippi) — Tissue Engineering

I am looking forward to the exciting opportunities for scientific exchange and professional development that are available for student members. In particular, applying for the Biomaterials Day grant is an outstanding chance to promote and share your research with fellow biomaterial scientists and to establish networks with both academia and industry. I would like

[CONTINUED ON PAGE 18]

Government News

By Carl Simon, Government News Editor

ADVANCED REGENERATIVE MANUFACTURING INSTITUTE

The U.S. Department of Defense has announced an award of $80 million to the nonprofit Advanced Regenerative Manufacturing Institute (ARMI), located in Manchester, New Hampshire, and led by Dean Kamen (armiusa.org). This award will help fund the creation of an Advanced Tissue Biofabrication Manufacturing Innovation Institute (ATB-MII). ARMI will operate ATB-MII as BioFabUSA within the Manufacturing USA network (manufacturingusa.com). BioFabUSA is an 87-member coalition that will match the $80 million in federal funds with $241 million in nonfederal cost sharing. The goal of BioFabUSA is to establish a public-private partnership that will "develop next-generation manufacturing techniques for repairing and replacing cells, tissues and organs for wounded service members." The institute will encompass "state-of-the-art tissue manufacturing, cell and biomaterial processing; 3D bioprinting; automation; and nondestructive testing technologies."

NATIONAL INSTITUTE FOR INNOVATION IN MANUFACTURING BIOPHARMACEUTICALS

The Department of Commerce announced an award of $70 million to support the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) headquartered at the University of Delaware (niimbl.us). NIIMBL also has support from an initial private investment of at least $129 million from a consortium of 150 industry and academic partners. NIIMBL is the 11th institute in the Manufacturing USA network. NIIMBL will "advance U.S. leadership in the biopharmaceutical industry, foster economic development, improve medical treatments and ensure a qualified workforce by collaborating with educational institutions to develop new training programs matched to specific biopharma skill needs." Surveys to identify project areas found that process development and analytical methods were of the greatest interest. Please see the NIIMBL website for more information on quick-start projects that are being developed.

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Greetings from the SIG Representative

By Sarah Stabenfeldt, SIG Representative

I want to quickly introduce myself and note that I am honored to serve as your SIG representative for the next two years. I'm an associate professor at Arizona State University's School of Biological and Health Systems Engineering, where I lead my research team in developing regenerative medicine strategies for acute neural injury. I come to this position with four years of SIG leadership experience serving as vice chair (2013 – 2015) and chair (2015 – 2017) of the Engineering Cells and Their Microenvironments (ECTM) SIG. It was through these positions that I saw firsthand the impact that SIGs have on developing conference programming and promoting biomaterials research to related scientific communities. I am excited to work with the SIGs over the next couple of years on a variety of initiatives.

At the Annual Meeting in April, there was a changing of the guard for each SIG's leadership. The main objective of the SIGs is to promote the mission of SFB by nurturing programs that will enhance SFB education and increase SFB enrollment. This objective will be achieved by promoting and enhancing education of SFB members within each SIG research area, enhancing communication with and among SFB members within each SIG research area, facilitating networking of SIG members, and promoting SIG membership. Each SIG has the opportunity to tackle these goals with strategies that best suit their membership. One example is from the ECTM SIG, which held a trainee poster competition this past year to recognize high-achieving trainees. Another example is the coordinated social event hosted by the Drug Delivery SIG, Immune Engineering SIG, Nanomaterials SIG and Tissue Engineering SIG that facilitated an engaging networking opportunity for the SFB community.

In closing, I look forward to working with everyone on future SIG events and initiatives in the next couple of years.

A **SNAPSHOT** from the 2017 SFB Annual Meeting

Allan Hoffman, University of Washington professor of bioengineering, received the 2017 Acta Biomaterialia Gold Medal Award. The award is given annually for "excellence in research and development in the biomaterials field." Allan Hoffman is the 10th recipient of this award.

In Their Own Words

Editor's Notes: *Since 2016, SFB has been awarding the Cato T. Laurencin Travel Fellowship, named in honor of Dr. Cato Laurencin, founding director of the Institute for Regenerative Engineering and founding director of the Raymond and Beverly Sackler Center for Biomedical, Biological, Physical and Engineering Sciences at the University of Connecticut. This fellowship aims to promote diversity, inclusion and success within STEM fields. To encourage minority representation in the field, the travel fellowship provides undergraduate students with the resources needed to become an SFB member and attend the Annual Meeting. Fellows are paired with a mentor to serve as a guide and advise them in pursuing advanced degrees and their career goals.*

The 2017 recipients are Nicole Friend of the University of California, San Diego; Divinefavor (Taiwo) Osinloye of the University of Illinois at Chicago; and Jeremy Nortey of North Carolina State University.

We asked these recipients to tell us what receiving the Cato T. Laurencin Travel Fellowship and attending the SFB Annual Meeting meant to them. Here is the feedback from these highly accomplished awardees.

NICOLE FRIEND

I feel very fortunate to have received the 2017 Cato T. Laurencin Travel Fellowship because without it, I would not have had the means necessary to attend the Society For Biomaterials Annual Meeting, which was a truly inspirational and influential experience. I had an interesting undergraduate career because I majored in bioengineering–biosystems, which focused more on medical device development, but I actually found a passion for using biomaterials in tissue engineering and regulative medicine research. Although I enjoyed my major, I found that it is not the field I want to pursue in my future research. Most of what I was learning in my courses wasn't very applicable to what I was researching outside of class, so I was very excited to have the chance to attend a conference that would allow me to expand my knowledge of biomaterial development and applications.

On the first day of the conference, I was able to meet Dr. Laurencin and watch him give an overview of his research. He really is a wonderful researcher and role model, and I aspire to accomplish as much as he has throughout my career. After meeting him and hearing firsthand about his accomplishments, I felt even more privileged to have received an award in his name. In addition to meeting Dr. Laurencin, I was able to interact with a multitude of other successful researchers after talks and during poster sessions. The organization of the research talks really helped me manage my time to gain exposure to the areas I felt were most interesting. Having attended the conference, I feel I am more prepared to conduct independent research on my own as I am more familiar with the types of questions I should be asking as I pursue a future career in biomaterials.

As a graduating senior pursuing graduate school this fall, April was a very busy time for me, especially because I had not decided which university I wanted to attend. With the deadline quickly approaching in the upcoming weeks, SFB was actually one of the most helpful opportunities I had in making my decision because I was able to interact with many of the faculty I had previously interviewed with at various universities. These interactions, along with a greater knowledge of research being conducted in the field of biomaterials, helped me determine the types of research I was most interested in pursuing for my PhD, which helped me narrow down my top choices for graduate school.

I could not be more honored to have received this travel fellowship, and I am extremely grateful to have been given the opportunity to attend the SFB Annual Meeting. I am excited to now be a part of the SFB community, which is filled with so many wonderful scholars, and I am looking forward to attending these Annual Meetings in the future.

DIVINEFAVOR (TAIWO) OSINLOYE

First of all, I want to thank my mentor, Dr. Tolou Shokuhfar, for welcoming me into her research lab, for giving me the opportunity to develop my knowledge in the field of biomaterials, for her recommendation and for her compassionate assistance in my application and preparation for the Cato T. Laurencin Travel Fellowship. Her compassion and willingness to see me grow is priceless, and I deeply appreciate her for that. Moreover, I would like to thank the Society For Biomaterials Committee for selecting me as an award recipient, as well as Dr. Cato Laurencin, Dan Lemyre and everyone who helped to select and sponsor my participation in the SFB Annual Meeting. Also, I thank Deb Dupnik for her kind assistance in communicating with me and helping me through the process of getting to the meeting; the board members were so friendly!

I am so undeniably thankful for the Cato T. Laurencin Fellowship Award and every aspect of the SFB Annual Meeting. It personally touched my heart to receive this award because it meant that the Society For Biomaterials believed in my dreams to positively contribute to society and my fellow humans, so much so that it was willing to support and sponsor it. I cannot take that for

granted. The congratulations email came to me unexpectedly as I was preparing to attend a morning class in my university. Let me just say that whatever concerns I had that day vanished, and that a smile was on my face for the rest of the day and even the entire week to follow. Since then, an extra sense of motivation has been "fueling" me to continue in my studies, as well as to continue in the pursuit and accomplishment of my dreams …

I am also grateful for every aspect of the Annual Meeting. It included presentation sessions, in which topics such as tissue and regenerative engineering were covered. Presenters from universities all over the world shared PowerPoint slides on their current and innovative research. I tried my best to take some notes and even ask a few questions afterward. To be honest, a lot of the information was new to me, and the presenters used a lot of "technical" terms that got my mind busy. Nevertheless, after each presenter gave his or her presentation, I began to get more familiar with the technical terms that were used. Furthermore, the presentations helped me to get a better idea of the biomaterials field as a whole as I began to even pick up on a few patterns and consistencies among the presenters. Humbly, I definitely still have ways to go, but I am extremely grateful for the opportunity to have had the "exposure" to the field, the presenters, the diversity and environment that the Cato T. Laurencin Travel Fellowship provided. My mentor even encouraged me to relax a little and enjoy Minneapolis with my parents, who accompanied me on the trip — I'm grateful that I took her advice! I am also thankful for the opportunity to present my poster during the student poster sessions, as well as to attend the student luncheon session. During these sessions, I got to chance to represent my school and develop more confidence in delivering presentations and being critiqued. I also took the opportunity to walk around and meet the other award winners, as well as chat with and learn from the other poster presenters, who came from many different universities and diverse backgrounds.

Finally, I would also like to mention my appreciation for the opening and closing cocktail parties; the food was delicious and elegant, and Guitar Hero was an excellent touch to the party — what an awesome way to top off the entire event! I give God the glory for everything, and thank you Society For Biomaterials for graciously welcoming me as a member of your organization!

JEREMY NORTEY

Receiving the Cato T. Laurencin Travel Fellowship was more to me than just receiving recognition for my work. The fellowship was a door into more opportunity, which was something I did not expect. The fellowship allowed me to attend my first research conference, where I was able to present my work, network with professionals and explore the city of Minneapolis. I had been working in my research lab for two years, and I had communicated with the principal investigator of the lab that I was very interested in attending any research conference. I was elated when she passed along the information about the Cato T. Laurencin Travel Fellowship. A couple of months later, I was presenting my work to some of the top professionals in the field of biomaterials. I was able to attend research talks and discussions that opened my eyes to how wide this field of science was. I was even able to meet Dr. Laurencin.

Meeting Dr. Laurencin was an incredible, unexpected opportunity. I listened to the story of his life's work and what he was currently working on. Moreover, I was able to converse with him about my future plans, and he agreed to support my plans by writing me a letter of recommendation.

The Annual Meeting was an excellent experience. I know I would not have gone to the SFB Annual Meeting if I had not received the travel fellowship. I thank Dr. Laurencin and all associated with SFB for providing me this opportunity. Also, I look forward to the next Annual Meeting!

For more information about the Cato T. Laurencin Travel Fellowship or an application, please visit biomaterials.org/awards/cato-laurencin-travel-fellowship.

To make a donation to the fellowship in honor of Dr. Laurencin, please contact the Society For Biomaterials headquarters directly at 856-439-0826 or info@biomaterials.org, or visit our website at biomaterials.org/donate. As a 501(c)(3) organization, all donations are tax deductible.

Updates from the Cardiovascular Biomaterials SIG

CARDIOVASCULAR CALCIFICATION: AN OLD PROBLEM IN NEED OF NEW SOLUTIONS

By C. LaShan Simpson, Agricultural and Biological Engineering, Mississippi State University

In a world of ever-evolving technology and trends, it is often assumed that some clinical issues become less relevant. The issue of calcification continues to plague the cardiovascular field. Calcification remains the most prominent precursor to hypertension, stroke and valve stenosis. Both valvular and arterial calcification continue to remain important clinical issues and are major causes for morbidity and mortality all over the world.[1,2]

The Cardiovascular Biomaterials SIG is sponsoring a special session titled "Current Approaches to Treat Cardiovascular Calcification" for the 2018 Annual Meeting. This session was inspired by a recent *Arteriosclerosis, Thrombosis, and Vascular Biology* article titled "Killing Me Unsoftly: Causes and Mechanisms of Arterial Stiffness."[3] This article highlighted advancements in the field to address the issue of arterial stiffness but emphasized the need for novel therapeutics to address this issue. Cardiovascular calcification is a common complication of heart disease and increases patient mortality. Calcification reduces arterial elastance and impairs valve function. Current treatments for both arterial and valvular calcification are limited, and the underlying mechanisms remain unknown. This session will cover new approaches to treat calcification in arteries and valves.

One of the Hot Line Vlog topics from the 2016 European Society of Cardiology meeting held in Rome, Italy, discussed a clinical study comparing drug-eluting stents with bare metal stents, and no significant difference was observed in death and non-fatal spontaneous myocardial infarction rates over five years.[4] In addition, current treatments still do not fully address the issue of restenosis. New research is needed to improve the efficacy of stents and reduce the rates of restenosis following stent procedures.

Recent advancements toward treating cardiovascular calcification include the use of vitamin K as a potential therapy for aortic valve calcification[5] and doxycycline being used to downregulate genes associated with aortic calcification in a rat model.[6] Nosoudi et al showed EDTA and PGG to be effective at reversing calcification when delivered via nanoparticles as a theranostic therapy.[7]

Another issue limiting the progression of effectively treating cardiovascular calcification is an incomplete understanding of the vascular biology, mechanisms and signaling pathways leading to the initial onset of calcification. Recent evidence has confirmed that mature vascular smooth muscle cells are not terminally differentiated.[8] Boström outlined the numerous signaling pathways that contribute to vascular calcification and affirm the plasticity of the vasculature.[9] She went on to state that the major challenge is to now translate this knowledge into therapeutics. Possible therapeutics include protein-based therapy[10] and blocking signaling pathways.

We hope that the session on "Current Approaches to Treat Cardiovascular Calcification" will lead to an engaging discussion of research being performed by Society members to treat cardiovascular calcification. This session could also spark collaborations among researchers that could lead to the next great breakthrough therapy for cardiovascular calcification. We encourage any members working in the field of cardiovascular calcification to submit an abstract for this session. Research topics, from new fixatives for bioprosthetic valves to prevent calcification, nanotherapeutics to treat arterial calcification, cell and gene therapy approaches to reduce calcification, and modeling and imaging techniques to detect early stage calcification, are all welcome.

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Updates from the Nano Engineering SIG

SELENIUM NANOPARTICLES: PROPOSED ENDOTHELIAL GLYCOCALYX-TARGETED ATHEROSCLEROSIS TREATMENT

By Ronodeep Mitra, Priya Prabakaran, Ming J. Cheng and Eno E. Ebong, Departments of Chemical Engineering and Bioengineering, Northeastern University

From left to right: Ronodeep Mitra, Priya Prabakaran, Ming J. Cheng, Eno E. Ebong

INTRODUCTION

Atherosclerosis is the leading predecessor to cardiovascular events, including strokes and myocardial infarctions. At present, there is no way to prevent atherosclerosis, and treatment methods are primarily restricted to alleviation of cholesterol levels and thrombosis. Here, we summarize the involvement of inner blood vessel glycocalyx (GCX) in vascular protection and in the progression of atherosclerosis. In addition, we propose a selenium nanomedicine-based therapeutic strategy for targeting GCX to improve atherosclerosis treatment.

ROLE OF ENDOTHELIAL CELLS AND GCX IN ATHEROSCLEROSIS

Atherosclerosis occurs due to dysfunction of the vasculoprotective endothelium, which is the innermost layer of the vessel or arterial wall.[1] The vascular endothelium is able to sense changes in hemodynamic forces and biochemical stimuli by modifying vasomotion, homeostasis, angiogenesis and vascular growth. This is achieved due to the actions of endothelial cell (EC)–derived vasoactive factors such as vasodilators, via suppression of smooth muscle cell growth, and by inhibition of inflammatory responses, along with a number of other functions.[2,3]

Proper endothelial functionality heavily relies on the expression of GCX, which coats luminal blood vessel wall ECs. GCX is a negatively charged, 7-nm porous, polysaccharide mesh. It acts as a functional buffer and filter between flowing blood and the vessel wall. As a result, GCX is a first line of defense against vascular diseases, including atherosclerosis. GCX is sensitive to oxidation, which breaks down its components and enables EC dysfunction and the progression of atherosclerosis. GCX degradation causes increases in lipid flux and lipid deposits in vessel walls, a hallmark of atherosclerosis. GCX degradation also alters communication between ECs and their neighboring ECs and enables ECs to increase interaction with inflammatory cells that attempt to migrate into the vessel wall. Furthermore, GCX degradation deregulates vascular tone by causing ECs to reduce their expression of the vasodilator, nitric oxide. Loss of vasodilation supports vasoconstriction, which promotes the progression of atherosclerosis. Targeting degenerated GCX could restore proper endothelial functionality and help prevent or delay the onset of atherosclerosis.

ATHEROSCLEROSIS STANDARD-OF-CARE TREATMENTS

At present, there are no methods available for preventing atherosclerosis. On the other hand, there are a number of commercially available standard-of-care treatments that reduce the severity of atherosclerosis and mitigate the risks for cardiovascular events such as myocardial infarction, stroke and transient ischemia attack. These available treatments primarily alleviate cholesterol levels and thrombosis.

Statins represent the primary therapy used to reduce atherosclerosis and cardiovascular events. Statins have shown to stabilize atherosclerotic plaques by reducing lipid levels in the blood.[4] Crisby et al[5] and others have shown the significant benefits of pravastatin use. Crisby and colleagues administered pravastatin to one group of patients, while another group of patients received no treatment. After the treatment period, atherosclerotic plaques were surgically removed from both patient groups and histologically analyzed. The analysis showed that plaques removed from patients who were given pravastatin had significantly less lipid content and, consequently, less inflammatory cell infiltration.[5] Crisby was able to conclude that pravastatin-treated patients had more stable atherosclerotic plaques.

Aspirin is another well-known anti atherosclerotic drug. Aspirin has a number of effects, including anti-inflammatory effects, but most relevant to mitigating atherosclerosis symptoms is its ability to reduce thrombus formation.[4] Aspirin's primary mechanism of action involves platelet deactivation, reducing the ability of platelets to release the bioactive substances that promote platelet aggregation and thrombus formation.[6] Platelet activity is a physiological requirement to control bleeding. Therefore, aspirin is not suited for primary prevention of atherosclerosis.[6] Aspirin-induced platelet inhibition has been shown to be effective only as a secondary atherosclerosis preventive measure for patients who exhibit more advanced stages of the disease.

CONSIDER TARGETING GCX

We propose that therapies be developed that will promote GCX health to reverse endothelial dysfunction, an early indicator for

atherosclerosis. With stabilized GCX structure and function, we expect that ECs will block lipoprotein deposits and macrophage uptake in the blood vessel wall, arresting progression of early plaque. In addition, GCX therapy could potentially stimulate antiatherosclerotic EC cell-to-cell communication and nitric oxide signaling pathways. GCX-targeted therapy would, for the first time, enable early atherosclerosis treatment. Regarding the aforementioned commercially available drugs, the benefits to GCX beyond the officially approved indications are largely unknown. There have been some recent developments of approaches to either stabilize GCX structure or replace missing GCX components with substitutes in cell culture, preclinically, and in studies conducted in human subjects. These approaches are not yet market approved for the purpose of restoring or protecting the GCX. In addition, GCX stabilization[7,8] or component replacement[9–15] have been pursued systemically, although it would be much better to specifically target only the vascular sites of GCX degeneration.

NANOPARTICLE-BASED THERAPY AND SELENIUM

Nanomedicine approaches, in theory, can be used to target and deliver a therapeutic only to endothelium sites where GCX is compromised, thereby avoiding side effects to other parts of the body. Nanoparticles are improving medicine, because they can easily travel through the body to deliver therapies to targeted locations.[16,17] In cancer medicine applications, nanoparticles access tumors by traveling to an overexpressed and exposed ligand through highly permeable vasculature. Nanoparticle drug delivery effectiveness for cardiovascular medicine also benefits from overexpression of certain ligands in disease settings, but access to nanoparticle drug carriers has been challenged by GCX due to limits imposed by the 7-nm porosity.[18,19] This pore size is smaller than most nanoparticle drug carriers, which have typical diameters ranging from 50 nm to 200 nm. In atherosclerosis, GCX pores over time become larger due to degradation, increasing permeability through to ECs. However, most nanoparticles are still too large to take advantage of this structural change in GCX.

A common material used to make particles at nanoscales that can contend with GCX is gold, because it is inert and its surface can be modified and functionalized. Unfortunately, gold inherently is not therapeutically active and is not biodegradable. Another available option is liposomes, which are often biodegradable lipid carriers used in drug delivery applications. However, they also do not have innate antiatherosclerotic properties. One material that may be of interest is selenium, which can be surface modified and functionalized; it also possesses the advantages of being antioxidant, biodegradable and antibacterial. Selenium nanoparticles can be synthesized to small sizes, ranging between 50 nm and 60 nm, by controlled reduction of sodium selenite solution by a glutathione solution. Addition of bovine serum albumin in deionized water to the selenium selenite solution quenches the formation of larger particles.

The use of selenium is highly controversial because it is toxic when overused. However, selenium is nontoxic at low concentration and essential for the human body. About 80% of the selenium that is naturally present in the body is synthesized into selenoproteins and transported to the cells. Selenoprotein is a precursor to selenoprotein P, an extracellular glycoprotein with selenocystein residues in the polypeptide chain. When present on ECs, selenoprotein P protects ECs from oxidative damage. This antioxidative property of selenium is anticipated to be beneficial for protecting GCX, suggesting that a selenium-based nanoparticle would be a promising therapeutic option due to its antioxidant properties. Supporting this idea, selenium supplements in nutrition have been seen to reduce atherosclerosis and coronary heart disease by preventing

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Industry News

By Steve Lin, Industry News Editor

HP has a storied past, but it may have an even more glorious future if it is able to deliver on its vision of industrial-scale 3D printing that can rival injection molding. It unveiled one year ago the HP Jet Fusion 3D Printing Solution, which prints quality parts up to 10 times faster and at half the cost of current 3D printers. Recently it launched its 3D Open Materials and Application Lab at its sprawling facility in Corvallis, Oregon, as part of its strategy for embedding 3D printing within the $12 trillion manufacturing sector. The Corvallis facility near Oregon State University was the birthplace of thermal inkjet technology some 30 years ago, and it remains a hotbed of innovation. Right now, all eyes are on the capabilities of its additive manufacturing system and the development of compatible materials. Multi Jet Fusion is the culmination of decades of research, and it has the potential to compete with conventional plastics processing techniques and engineer materials at the voxel (volumetric pixel) level.

AirXpanders has rolled out its AeroForm Tissue Expander System in more than 100 medical institutions and health systems across the United States. AeroForm offers a needle-free alternative for women who choose reconstructive surgery following a mastectomy. The device is activated by a handheld wireless controller that administers small amounts of carbon dioxide up to three times a day to gradually stretch the tissue to prepare for a breast implant. AeroForm was granted de novo clearance by the U.S. Food and Drug Administration (FDA) in December 2016. AirXpanders' device is expected to improve patients' experiences and empower them to take back control of their time and bodies after often long journeys through breast cancer. Studies show that 1 in 8 women in the United States will develop breast cancer, with mastectomy being the most frequently performed treatment (about 250,000 annually). The market opportunity for AirXpanders in the United States is significant, with the total addressable market worth more than $800 million.

GE Additive and **Stryker** have entered a partnership agreement to support Stryker's growth in additive manufacturing. The agreement covers new additive machines, materials and services for Stryker's global supply chain operations. The announcement was made at GE's Minds + Machines event, GE's premier industrial internet event dedicated to software, innovation and the sharing of the most powerful digital industrial outcomes. Stryker has already invested in Concept Laser and Arcam machines. The company's investment in additive manufacturing began in 2001; since then, Stryker has collaborated with leading universities in Ireland and the UK to industrialize 3D printing for the healthcare industry. Stryker recently opened a global technology development center with an additive technology manufacturing hub in Carrigtohill, County Cork, Ireland. Additive manufacturing allows Stryker to address design complexity and achieve previously unmanufacturable geometries.

Novartis and **Verily Life Sciences (formerly Google Life Sciences)** have joined the European Investment Fund as key investors in a new $300 million fund created by venture capital firm Medicxi to fund late-stage European life sciences companies. The new fund, Medicxi Growth 1, is designed to fill what investors say is a funding gap between European companies and their U.S. counterparts, attributed to the former having less access to local sources of capital.

Stryker announced a definitive agreement to acquire NOVADAQ Technologies Inc. for $11.75 per share, or $701 million with a net purchase price of $654 million, reflecting net cash of approximately $47 million. NOVADAQ is a leading developer of fluorescence imaging technology that provides surgeons with visualization of blood flow in vessels and related tissue perfusion in cardiac, cardiovascular, gastrointestinal, plastic, microsurgical and reconstructive procedures. NOVADAQ was founded in 2000 and is headquartered in Mississauga, Ontario, Canada.

The Congressional Budget Office (CBO) released its cost estimate for the FDA Reauthorization Act of 2017, noting that the bill would increase net discretionary spending by about $740 million during the 2017 to 2022 period if appropriation actions are consistent with the bill. Although the implementation would require increased funding for a variety of FDA activities, CBO reported that most of the increase in FDA spending would be offset by additional fees collected under the bill and used to reduce the need for discretionary appropriations. According to the report, the FDA Reauthorization Act of 2017 (S. 934) would apply pay-as-you-go procedures due to an increase in direct spending by $13 million and a decrease in revenue by $2 million during the 2017 to 2027 period. This would increase budget deficits by $15 million during the 2017 to 2027 period, CBO noted. Net direct spending or on-budget deficits would not be increased by more than $5 billion in any of the four consecutive 10-year periods starting in 2028. In aggregate, FDA would assess about $9 billion in fees — $8 billion for prescription drugs and $1 billion for medical devices — during the 2018 to 2022 period based on the fee levels and inflation adjustments specified in the bill.

ConforMIS, Inc., a medical technology company that offers knee replacement implants customized to fit each patient's unique anatomy, announced that it has received FDA 510(k) clearance of the company's primary iTotal Hip replacement system. The ConforMIS iTotal Hip system features proprietary

Industry News [continued]

iFit technology similar to that used to design, manufacture and deliver customized knee implants. The system uses ConforMIS' patient-specific technology, single-use 3D printed instruments and just-in-time delivery model to create a system that requires limited reusable instruments. In the United States, approximately 400,000 hip replacements were performed in 2016. The global hip joint reconstruction market is projected at more than $6 billion.

Minneapolis' *Star Tribune* reported on a securities filing by Medtronic, which said that as of June 1, 2017, it has reached agreements to settle "substantially all" of the 6,000 filed and threatened lawsuits over Infuse. It's not clear how much the settlements will cost. In the same filing, Medtronic said that it had allotted $300 million for all legal settlements in the fiscal year that ended in April. The company, which is now based in Dublin but whose spinal division is based in Memphis, paid $26 million in aggregate legal charges in the previous year. Medtronic's Infuse product drew controversy in 2011 when a group of spine specialists said the company overstated its benefits and interfered with supposedly independent studies. Medtronic later commissioned a new outside study that found no significant difference between Infuse and a more traditional bone graft. Medtronic said the study backed up its position that Infuse is safe.

Student Chapter Update [continued from page 10]

to encourage all current student chapters to submit their applications by Sept. 16, 2017. Selected applications could win up to $5,000 to support Biomaterials Day events. Last year, students organized seven successful Biomaterials Days in 18 university chapters in the United States, which shows the high proactivity and excellence of our SFB student and faculty members.

Upcoming Biomaterials Days include:
Aug. 4, 2017 — Hosted by Georgia Tech, Clemson University and Vanderbilt University
Oct. 6, 2017 — Hosted by the University of Michigan, University of Pittsburgh, Carnegie Mellon University and Case Western Reserve University

For more information on Biomaterials Days, please visit biomaterials.org and click on the Students section.

In addition, the General Council and the Education & Professional Development Committee are planning great activities for the next Annual Meeting in Atlanta, including several scientific sessions, workshops, tours of biomedical companies, awards and educational activities.

Finally, if you are interested in industry, great things will be happening in the Biomaterials and Medical Products Commercialization SIG. Members are currently evaluating a co-op matching program initiative in collaboration with the Tissue Engineering and Regenerative Medicine International Society and the Biomedical Engineering Society. To build and launch this program, representatives from these societies will evaluate current mechanisms and means by which students in our field can find co-op and internship positions.

Becoming a student member of the Society and getting involved with student chapters are great ways to enhance your career potential, including job opportunities. If your institution does not have a student chapter, we encourage you to create one with other students. A minimum of three student members and one faculty member to serve as advisor is all that is required to form a student chapter. For more information, please visit our website (biomaterials.org), and do not hesitate to contact me or the other members of the National Student Section for further guidance.

Updates from the Nano Engineering SIG [continued from page 16]

oxidation.[20] Selenium-poor diets have been shown to contribute to increased risk for atherosclerosis.

From further research, it can be determined if delivery of selenium by direct cell targeting using nanoparticle formation and nanoparticle functionalization approaches has a similar or better effect on preventing oxidative damage than nutritional selenium supplements. Future research is also needed to define levels of nanoparticle-based therapeutic selenium dosing that are nontoxic. Such selenium nanoparticle development — which has the potential to prevent oxidative damage of the GCX and associated EC dysfunction, maintain the integrity of the blood vessel wall and ward off atherosclerotic plaque growth — would bring significant advancement to the field of cardiovascular medicine.

Meet the Rising Stars

AN INTERVIEW WITH ANKUR SINGH

Editor's Notes: *Following is an interview with SFB's 2017 Young Investigator Award winner Ankur Singh, assistant professor in the Mechanical Engineering School and Biomedical Engineering School at Cornell University. In this role since 2013, he has made research contributions to the fields of immuno-engineering, biomaterials and lymphoma bioengineering. Dr. Singh's research seeks to understand how healthy and malignant immune cells sense and adapt to tissue microenvironment signals and how to engineer biomaterials-based lymphoid microenvironments to enable immune cell development for advancing fundamental immunology knowledge and translating therapeutics. His lab's main expertise is in engineering ex vivo immune organoids and tissues to understand the role of lymphoid tissue microenvironments on the kinetics of germinal center B cell activation and their malignancies (lymphomas). Additional emerging areas in his lab include cellular and molecular interactions of engineered nanomaterials with immune cells in chronic inflammatory conditions and cancer. Details of his research can be found at the Immunotherapy and Cell Engineering Laboratory web page (mae.cornell.edu/mae/research/groups/icel).*

Dr. Singh received his PhD in biomedical engineering from Prof. Krishnendu Roy's lab at the University of Texas at Austin. He then completed his postdoctoral training in the lab of Prof. Andrés García at Georgia Tech. Among the most recent awards that Dr. Singh has received in recognition of his innovation and research excellence are the National Science Foundation (NSF) CAREER Award, the Department of Defense Career Development Award, the National Institutes of Health (NIH) R33 Award from the National Cancer Institute's (NCI) IMAT program, the 2017 Prostate Cancer Specialized Programs of Research Excellence Initiative Award, the 2015 Biomaterials Outstanding Paper Award, the 2014 Young Innovator of Cellular and Molecular Bioengineering Award, and the 2014 Biomedical Engineering Society Rising Star Award. His work was highlighted in Discover Magazine*'s 100 Top Stories of 2015. In 2017, he was nominated and selected to attend the National Academy of Engineering EU-US Frontiers of Engineering Symposium.*

Guigen Zhang (GZ): First of all, I want to congratulate you again for receiving the SFB Young Investigator Award in April 2017 as well as many other awards. I would like to start by asking, When did you become interested in biomaterials research?

Ankur Singh (AS): Thank you, Guigen. It's an honor to be the recipient of such a prestigious award. I had some prior exposure to lipid-based drug delivery systems during my master's of technology at the Indian Institute of Technology–Bombay. I became seriously interested in biomaterials research in 2006 when I joined Prof. Roy's lab at the University of Texas

Image 1: Ankur Singh (front row, far right) with his students in a lab outing.

at Austin for my PhD. I was fascinated by the exciting prospects of modulating immune cells using biomaterials-based micro-nanoparticles. It was during this time that I learned about biomaterials, and my doctoral research then established multimodal, biomaterials-based DNA–RNA vaccines to enhance the potency of vaccines against cancer and infectious diseases. It was fascinating to learn and implement engineering strategies to program immune cells; I worked on biasing immunity toward a particular T cell type response.

GZ: Would you give some brief highlights of your research work? What impact you would like to make in terms of helping people and improving quality of life?

AS: As a bioengineer and an immune engineer, I combine interdisciplinary approaches such as biomaterials; fluid, tissue and material mechanics; and cell engineering with fundamental concepts of immunology and pathology. Our work has led to the development of ex vivo 3D immune organoids that can program naïve B cells into a very specialized population, called germinal center B cells, which eventually produce antigen-specific antibodies. We anticipate that such anatomically relevant, specialized and functional lymphoid tissues will aid development of effective vaccines against chronic diseases and infections from rapidly mutating viruses, while simultaneously lead to immune-related fundamental discoveries. The organoids could serve as a rapid testing platform to identify nonresponders or poor responders to particular vaccines before vaccine administration, enabling rapid testing of immunomodulators to convert such poor responders into good responders. In the long term, tunable organoids will also allow us to model disorders resulting from defective B cell process and B cell malignancies. Our research focus is also on understanding the role of lymphoid tumor microenvironment in B and T cell lymphomas and developing innovative, biomaterials-based platform

technologies to determine tumor heterogeneity and causes of drug resistance in lymphoma patients. Using this system, we are developing and testing new pathway- and epigenetic-targeting therapeutics. We hope that our translational technologies and mechanistic findings will explain why subclasses of lymphoma patients fail to respond to drugs and will lead to the discovery of new therapeutics.

GZ: How big is your research group? What can you share with our readers about the ways you run your group and motivate students or postdocs, or about the challenges and the rewards?

AS: We have nine PhD students and six undergraduate researchers (Image 1). The research atmosphere is interdisciplinary and diverse, with PhD students from biomedical engineering, mechanical engineering, material science and engineering, and veterinary medicine (immunology). Their diverse backgrounds provide a great niche for fostering creativity and innovation. Everyone is encouraged to share thoughts and findings through various mechanisms (group meetings and subgroup meetings, for example) and go to conferences like SFB's Annual Meeting that are rich in science and networking (Image 2). This thought process has led to discovering unknowns and has allowed us to overcome some of the toughest barriers in immunological research. We have a supportive culture, and students love to collaborate with each other in and outside of the lab. New students receive mentoring from me and peer mentoring from students who have advanced in broader project areas. I have made myself very accessible to my trainees, and I believe that has made quite a difference in mentoring and providing fast feedback. Our bimonthly whole-group meeting focuses on our journal club, and we have weekly research discussions in subgroup meetings. I find subgroup meetings to be highly rewarding, as the brainstorming process helps everyone grow together in a synergistic manner. I have been fortunate to have some of the best students at Cornell, who help each other with inevitable scientific challenges through intellect, constructive feedback and encouragement.

Image 2: Ankur Singh (second from left) with his PhD students at the 2017 Society For Biomaterials Annual Meeting.

GZ: You are very successful in securing research funding from highly competitive sources such as NSF and NIH. In your opinion, what are the keys to such successes?

AS: Being a tenure-track faculty is an incredibly difficult job that comes with enormous responsibility of maintaining high research standards — and continuous funding to support these standards. Although my very first NIH (R21) grant was funded from NCI in my first year at Cornell, grantsmanship improved with time. Grant writing is still a learning process for me, but I am happy to share a few thoughts: Start early on draft proposals; go through iterations of revisions before submission; and, if it helps, don't be shy about asking a colleague to read through the specific aims page. Establish collaborations early, if needed, and reach out to clinical collaborators on translational projects. Rejections are inevitable, and even some of my most successful peers faced a series of rejections in their early careers. In my opinion, it is important to carefully review feedback from study sections and revise. I often have found reviewer comments very useful, and they challenge me to expand my boundaries.

GZ: What can you share with our readers in terms of the do's and don'ts in research program development, proposal writing, etc.?

AS: I can only share my own perspective as an assistant professor; I am sure others have their own successful views, which I would be willing to hear. As a new assistant professor setting up my lab, there were several do's and don'ts for me. Your success is driven by the students you recruit, so I invested time in carefully deciding on my students. It was critical for me to engage in the PhD student recruitment process early on during visit weekends and look across multiple departments because of the interdisciplinary nature of my research. As my peers always remind me, in the pursuit of tenure (and I have yet to get mine), quality publications and successful funding are two of the hardest things to achieve. To be successful, you have to be smart, persistent and patient. Stay focused, follow your passion, don't get too attached to one paper or grant or project, and be ready to pivot when it is necessary. Make strong collaborations and pay attention to them. I worked with my department to stay off major, time-consuming departmental and institutional services early in my career, yet I contributed to Cornell through services that I was expected to.

GZ: To date, you have published about 40 papers and received some 13 grants as principal investigator or co-investigator. What percentage of your time is spent on writing papers or proposals?

AS: I don't think one can keep track of time in this job, but my students and kids say I work hard. (I do not agree!) Deadlines are always there, and I prioritize things as they come. That's why I start early on grant writing.

GZ: A successful young researcher often gives people the impression that work is his or her entire life. You seem to be doing extremely well balancing work and life with your two young daughters. How do you do it? Can you share with our readers something about your daughters and your family life?

AS: I have two very smart and beautiful daughters, Aanya (7 years old) and Aditi (3 years old). Aditi was born in my second year at Cornell, and it required a lot of extra time commitment. I quickly realized that my daughters' childhoods will not return and that deadlines will always be there, so I knew what I had to do. I give them and my lovely wife, Dr. Shalu Suri, who did her PhD with Prof. Christine Schmidt at the University of Texas at Austin, a lot of time throughout the week. When I am with them, I am fully with them. However, it is not easy to balance because sometimes your mind is preoccupied with work-related matters. As such, it is important to prioritize and choose what *not* to do so we can save time for people and tasks that are most critical. Besides work, I enjoy playing soccer with my oldest daughter; taking her to ice skating, soccer, swimming and piano lessons; and occasionally cooking for my family. Ithaca is a beautiful place for raising kids, surrounded by many waterfalls and trails to hike. Hiking is something new for me, and we have been hiking quite a bit lately now (Image 3). I often participate in the STEM programs at my daughter's school, where I teach diffusion of food dyes through gelatin as a biomaterial-based tissue building block. Quality time spent with my family continues to refresh and motivate me to excel in my job. My wife, who is a teaching faculty in biomedical engineering at Cornell, is my biggest supporter at every step in my career.

GZ: Looking ahead, what challenges do you see in realizing the impact you would like to make through your innovative research work?

AS: We are very comfortable with our ability to learn and develop new biomaterials. However, it is the evolving nature of cells and heterogeneous tissues that keep challenging us. We would like to humanize our organoid platform and eventually establish a company around similar technologies for rapid discovery and translation of therapies. We are working with a group of experts who know the ins and outs of clinical trials. Although some upcoming work clearly benchmarks our technology against state-of-the-art, we have a long way to go to prove how close we are to recapitulate aspects of human body. We will continue to look for funding opportunities in this area through various modes.

GZ: You mentioned several times about the needs to collaborate and work with the right partners and clinician scientists. How do you identify the right ones?

AS: When I started out as a new faculty, I focused on establishing my research program development and proposal writing. During this time, I developed my lab's core strengths and simultaneously identified an expert at Cornell Medical School who had the right expertise in lymphomas that I was looking for. I was able to foster a longstanding, successful collaboration with Prof. Ari Melnick, the Gebroe Family Professor of Hematology and Oncology at Weill Cornell Medicine in New York. My organoid research was well received by medical school and veterinary school faculty, which led to several new collaborations over the past four years. In my experience, the most rewarding collaboration comes when interest and effort is bidirectional — when expertise intersects orthogonally — and I have been fortunate to have several such collaborations.

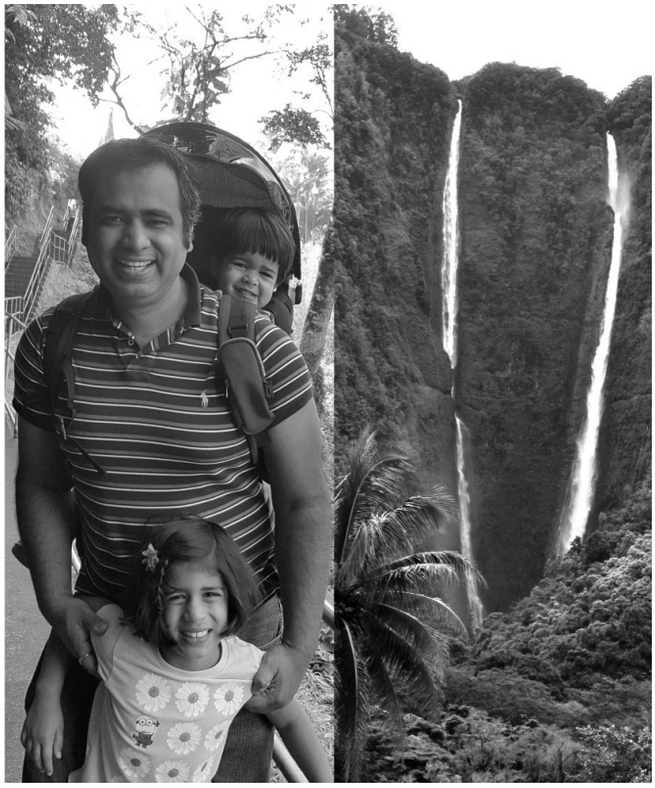

Image 3: Ankur Singh and his daughters, Aanya (7) and Aditi (3), hiking on the Big Island of Hawaii in January 2017.

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