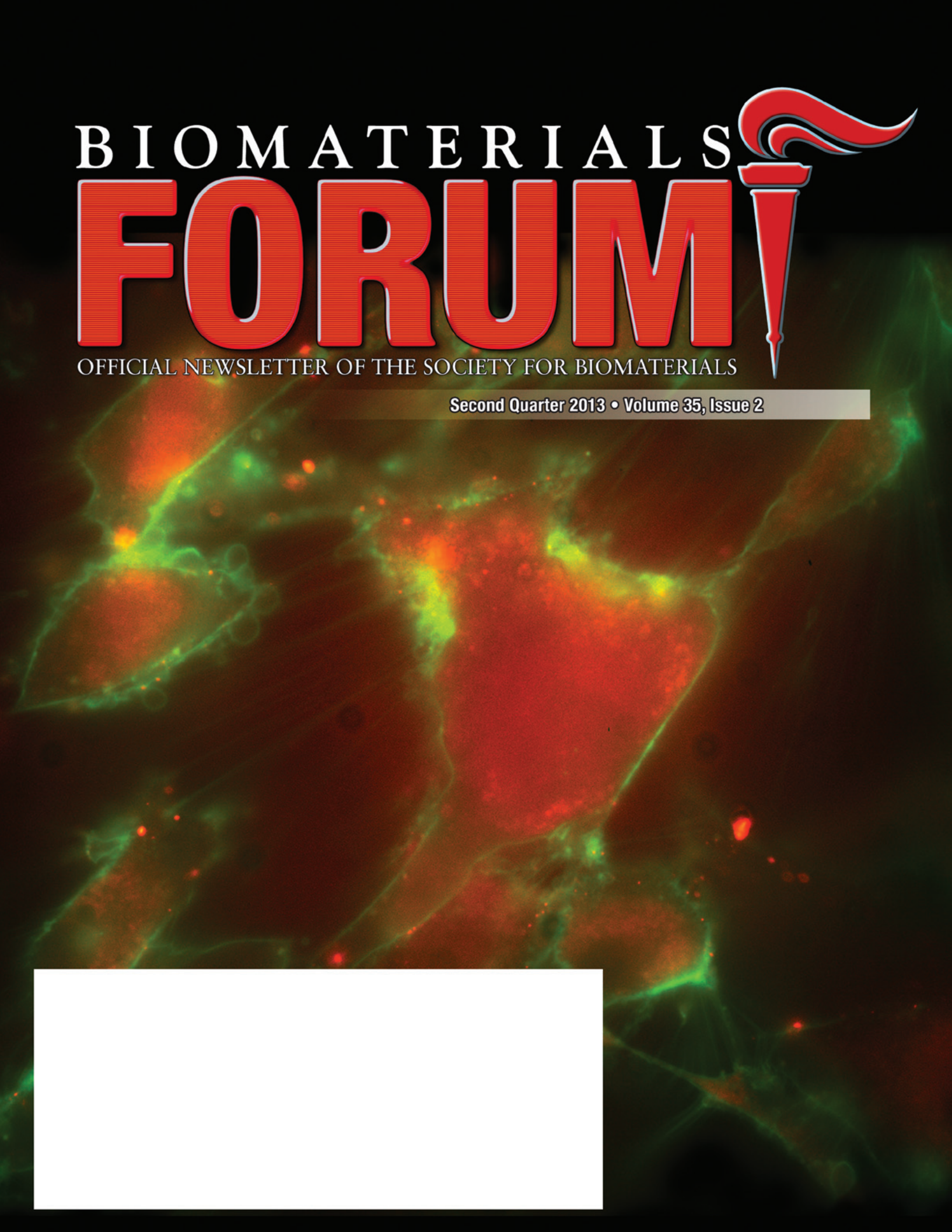
BIOMATERIALS FORUM

OFFICIAL NEWSLETTER OF THE SOCIETY FOR BIOMATERIALS

Second Quarter 2013 • Volume 35, Issue 2



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The official news magazine of the **SOCIETY FOR BIOMATERIALS** • Volume 35, Issue 2

Special Interest Group Reporters

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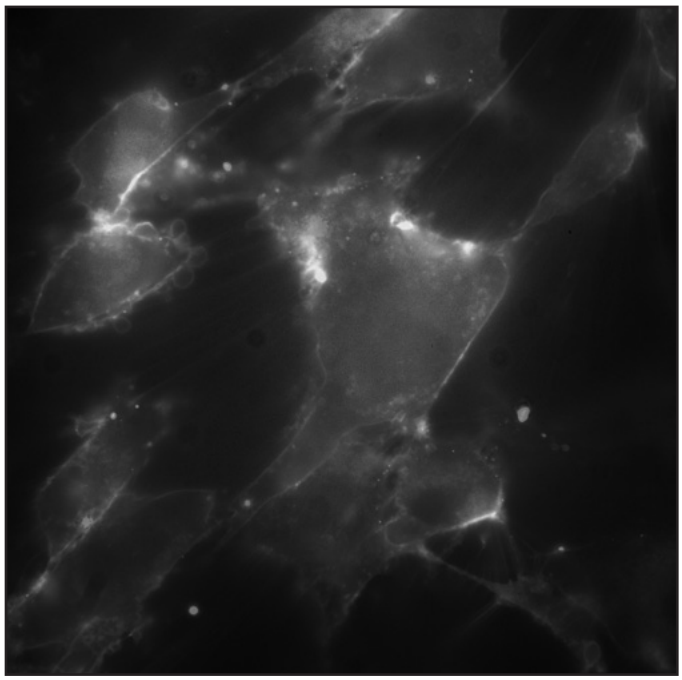
Departments

The Torch

News and Updates



On the cover: The uptake and intracellular separation of cyclosporine-A (CyA)-loaded polysialic acid-polycaprolactone (PSA-PCL) micelles within synovial fibroblasts. To facilitate fluorescence microscopic evaluation, PSA-PCL was conjugated to sulforhodamine 101 cadaverine, while CyA was synthetically modified to include a free amine moiety that was linked to Alexa Fluor® 488. Upon intracellular separation, the CyA strongly localized at the plasma membrane (green), while the carrier system (red) remained in the cytoplasm. Modified CyA and PSA-PCL were prepared by Nan Zhang, under the guidance of Rebecca A. Bader, in the Syracuse Biomaterials Institute at Syracuse University. Images were obtained by Martin B. Forstner in the Department of Physics at Syracuse University.

From the Editor

Greetings fellow biomaterials scientists,

We've assembled another interesting issue to help keep you up to date on the latest news in the world of biomaterials.

Here's a sampling of what you'll find within this issue:

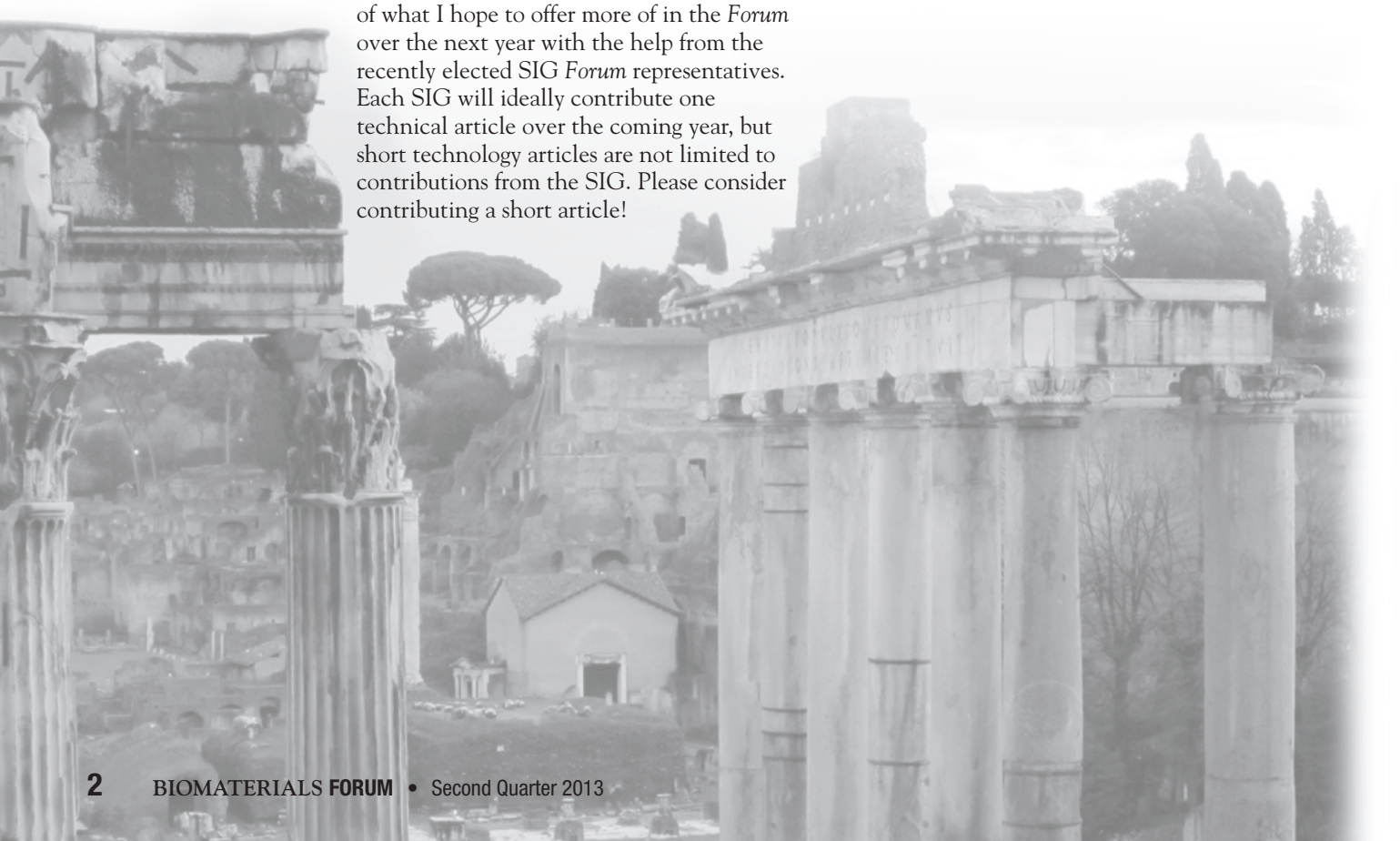
- The annual meeting of the Society For Biomaterials was just held in Boston, April 10-13. Summaries of some of the key events, new officers and award winners can be found on pages 16 and 17.
- Learn more about the vision of two new SFB officers, President Tony Mikos and Special Interest Group Representative Steve Little, on pages 3 and 18 respectively. Past President Joel Bumgardner provides reflections and thanks in a letter to the members on page 6.
- Announcements of prestigious professional awards, advancements and relocations of our SFB members can be found on page 8.
- A short technology article about the ways hydrophobic and hydrophilic forces can be manipulated to optimize biomaterials was contributed by the Proteins and Cells at Interfaces SIG. This article is a great example of what I hope to offer more of in the *Forum* over the next year with the help from the recently elected SIG *Forum* representatives. Each SIG will ideally contribute one technical article over the coming year, but short technology articles are not limited to contributions from the SIG. Please consider contributing a short article!
- Within the Industrial News column, you can read about burgeoning development of new diagnostics using cell phones or home kits that empower the patient to monitor their own health. The business outlook for the European device market continues to improve, while questions loom in the US due to medical care reform.
- A new journal focused on education in dental schools. See page 20.
- A review of a new book by Noam Eliaz about Degradation of Implants, page 25.

This magazine is here for you as one of several venues to share your important news and views with the wider biomaterials community. If you've got something to say about biomaterials, I invite you to submit a contribution for publication in the next issue. Please send it to me at Lkuhn@uchc.edu.

Best wishes,

Lisa Kuhn

University of Connecticut Health Center
Biomaterials Forum Executive Editor



From the President

The recent 2013 Annual Meeting and Exposition of the Society For Biomaterials was a tremendous success, and I would like to take this opportunity to congratulate Timmie Topoleski and the entire Program Committee for the exceptional effort they invested in developing such an inspiring scientific program and enjoyable meeting. I would also like to express my gratitude on behalf of the Society to the sponsors and exhibitors for their very generous support and active contributions to the success of the meeting. The theme, "A Biomaterials Revolution," creatively acknowledged the collective contributions of our Society over time toward advancing medicine, while appreciating the prominent historical role of our host city of Boston. As we reflect upon the success of the meeting, our thoughts remain with the people of Boston and all those affected by the recent tragic events associated with the Boston Marathon.

As I transition into the role of President of the Society, I wish to congratulate Joel Bumgardner, our Immediate Past President, for his exceptional leadership. I also extend my sincere appreciation to the members of the Long Range Planning Committee for their outstanding service and leadership in thoughtfully considering the present state of the Society and developing strategic recommendations to guide the long-range direction of the Society to ensure our continued eminence and success. I would also like to congratulate Nick Ziats for his election as President-Elect of the Society and his associated role as Chair of the Long Range Planning Committee. I look forward to working together closely with Nick and the Committee this year to prioritize and begin implementing several strategic recommendations offered by the Committee, which were adopted recently by the Society. Through the collective efforts of these and other leaders, we are strongly positioned to maintain our current prominence in the global biomaterials field and to explore avenues to reinforce the vitality of the Society.

The future of the Society depends upon the active participation of the students of today who will transition with time to be the leaders of the Society. As the Society's membership numbers continue to expand, we must remain committed to encouraging student participation, fostering their professional development and providing value in order to promote continued active engagement with the Society as they transition into their careers. The Society should also continue to encourage increased representation and active participation of those engaged in clinical practice and industry, which will foster the continued interactions necessary for the clinical and commercial translation of biomaterial-based technologies to advance patient care.

The Annual Meeting serves an indispensable function in promoting such interactions between members of all backgrounds, and in this spirit I am pleased to announce Helen Lu (Columbia University) and Peter Edelman (Boston Scientific) will represent academia and industry, respectively, as Program Co-Chairs for the 2015 Annual Meeting. Indeed, we look forward to building upon the momentum and success of the 2013 Annual Meeting in Boston as we prepare for the 2014 Annual Meeting in Denver and the 2015 Annual Meeting in Charlotte. I invite you to join us in contributing to the success of these meetings and the future of our Society!

Antonios G. Mikos
President, Society For Biomaterials

Staff Update from Headquarters

Leslie Clark, Assistant Executive Director

Hello from Society For Biomaterials headquarters. Our thanks and appreciation to the great city of Boston for hosting the 2013 annual meeting! With the beginning of a new program year, the Society's board of directors, governing council, committees, task forces and SIGs will be working to advance the Society's mission as described below. Also below are some updates from the meeting.

2013 Annual Business Meeting:

The 2013 annual business meeting was held Friday, April 12, at 3:00 p.m. The 2013-2014 officers were announced:

President-Elect:

Nicholas Ziats, PhD, Case Western Reserve university.

Secretary/Treasurer-Elect:

Lisa Friis, PhD, Kansas University.

Member-At-Large:

Jan Stegemann, PhD, University of Michigan.

The members present approved the proposed changes to the bylaws (making it much easier to join the Society as an active member and eliminating the need to elect members of the Membership Committee), and they elected four new members to the Awards, Ceremonies and Nominations Committee. In addition, Laura Suggs reported the Society is in good health financially, and the Board and Council will be looking to invest more in developing and delivering services to members.

Awards, Ceremonies and Nominations – Chair Nicholas Peppas

Elected members of the committee include: Mariah Hahn; Joachim Kohn; Alan Litsky; and Rich Payne. The Awards, Ceremonies and Nominations Committee is soliciting nominations for the 2014 awards and the President-Elect and Member-At-Large position for the 2014-2015 program year. If you intend to make a nomination for a 2014 award, please send a brief letter of intent to headquarters (info@biomaterials.org) by June 30. The deadline for award nominations is September 13, 2013. The deadline for officer nominations is September 20, 2013.

Bylaws – Chair Jiro Nagatomi (reappointed)

With the passage of amendments to remove barriers to membership and to allow Membership Committee members to be appointed rather than elected, the Bylaws Committee will be focusing on methods to further engage industry members and reviewing the bylaws for any inconsistencies created by past amendments.

Devices and Materials – Chair Andy Doraiswamy (reappointed)

The committee is exploring ways to further engage industry members and re-invigorate the award nominations solicited for the Society's industry awards. In addition, the committee will be submitting specific proposals for the 2014 annual meeting program focused on delivering content for industry members.

Education and Professional Development – Chair William Murphy (reappointed)

The EPD Committee helped organize student and women's luncheons at the 2013 annual meeting and the first-ever Biomaterials Education Challenge. With 11 competitors presenting their plans for educational outreach to seventh and eighth graders, Case Western Reserve University took home the top prize of $2,500! Prizes were also awarded for second (Texas A&M University), third (Columbia University) and fourth place (University of Memphis). More details on the Biomaterials Education Challenge and the submissions can be found in the article submitted by Bill Murphy on page 10.

The committee also presented the 2013 C. William Hall Scholarship to Benjamin Fuller from the University of Minnesota and supported the Student Travel Achievement Recognitions (STARs) program with 26 STARs awarded and 24 honorable mentions.

Finance – Chair Lisa Friis

Development of the 2014 budget will begin in late summer. All committee chairs and SIG treasurers are requested to submit 2014 budget requests by August 15, 2013.

Liaison – Chair Dave Puleo

The Liaison Committee continues its efforts to coordinate and collaborate with other societies. We are pursuing interactions with domestic and international organizations encompassing engineering, life and clinical sciences. If you are interested in furthering collaborations with another society, please contact headquarters.

Long Range Planning – Chair Nicholas Ziats

The Board and Council have approved the long range strategic plan prepared by the committee over the last two years. Input from every segment of membership, all committees and SIGs was solicited and incorporated. Now the committee will focus on prioritizing these initiatives and "operationalizing" the recommendations made in the plan. The new mission and vision statements approved as part of the plan are below. The complete plan is available by request, please contact headquarters.

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

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

Meetings – Chair Antonios Mikos

The 2014 meeting will take place in Denver, April 16-19, 2014, and the 2015 meeting will take place in Charlotte, N.C., April 15-18, 2015. The committee will begin planning for the 2014 Bash and site selections for 2016 and 2017 in the near future. The 2015 Annual Meeting will be co-chaired by Peter Edelmen, PhD, Boston Scientific, and Helen Lu, PhD, Columbia University

Membership – Chair Horst von Recum (reappointed)

The committee will be focused on promoting membership, marketing and the continued development of student chapters. In addition, the committee will be investigating ways to convert a larger number of participants in the Biomaterials Day grant programs and student chapters to full members.

Program – Chair Joo Ong

The 2014 Program Committee will be soliciting the Society's membership for ideas for the 2014 meeting in May. Ideas will be reviewed in June with full proposals requested in July. The call for abstracts will be published by Labor Day, and the abstract deadline will be in early November.

The keynote speaker for the 2014 Meeting will be Joe DeSimone from the University of North Carolina at Chapel Hill. Additional details will be made available on www.biomaterials.org as they become available.

Publications – Chair Alan Litsky

The Publications Committee distributed a number of press releases concerning the meeting to local media outlets in the Boston area. The committee continues its work with the bi-weekly e-newsletter, the *Biomaterials Bulletin*, and will be working with the website redesign task force on a complete overhaul of the Society's website in the months ahead.

National Student Chapters – President Beth Pollot

Students are encouraged to submit ideas for the 2014 annual meeting for general programming and student-specific programs. National Student Chapter officers will be working with the Education and Professional Development Committee to refine the Biomaterials Day grant program and to establish priorities for the 2014 operating budget.

Special Interest Groups – Representative Steve Little

Newly elected officers for the 2013-2015 term have been installed. The new SIG representative to the board of directors (Steve Little, University of Pittsburgh) has established three priorities for each of the SIGs: increase the value of the SIGs; grow the SIGs; and develop content for the 2014 meeting.

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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Outgoing President's Message

Dear SFB Members,

It has been an honor and a privilege to serve as President of the Society for Biomaterials this past year. I can truly say it has been a most enjoyable, challenging and professionally fulfilling experience, and I am deeply grateful for the support of many individuals. I would like to especially thank the executive leadership committee, Tony Mikos (President-elect), Laura Suggs (Secretary/Treasurer) and David Kohn (Secretary/Treasurer-elect), who were extraordinary over the year in their support, guidance and enthusiasm for me and the Society. I also must thank Karen Burg and Jeremy Gilbert, who, as past-presidents, were great resources in providing perspective on many issues. We have accomplished much together this year, and we could not have done it without the leadership and dedication of the members of the board and council–we are indebted to them!

Please forgive my indulgence to recognize and thank these individuals:

- Nick Ziats (Member-At-Large) for always reminding us of the members and greater biomaterials community we serve and promote.
- Jeff Schwartz (SIG-Chair Rep), who has engaged a large segment of the membership and energized them with the electronic *SIGnal* newsletter for the SIG members.
- Lynne Jones and her Awards, Ceremonies and Nominations Committee for helping to identify and recognize the great leaders and innovators in the field during the plenary sessions, and for new leaders of the Society.
- Jiro Nagatomi and his Bylaws Committee, for the thoughtful, measured and consensus-building way he undertook revising the way individuals become members of the Society. I strongly believe this change will open the Society to new members and advance the Society's mission for promoting all aspects of biomaterials.
- Horst von Recum and his Membership Committee for their focused, insightful and dedicated cooperation with the Bylaws Committee on the membership changes.
- Tony Mikos and the Long Range Planning Committee, also for their cooperation in working on changing the membership, but also for reaching out to the members and all committees in furthering the strategic plans of the Society–this is, indeed, a living plan and will provide a great platform for advancing the Society to achieve its vision.

I can truly say it has been a most enjoyable, challenging and professionally fulfilling experience, and I am deeply grateful for the support of many individuals.

- William Murphy and his Educational and Professional Development Committee for not only continuing to work with the student chapters and the women in science groups, but in launching the first SFB National Student Challenge competition–it was an immense success, and it will only further the recognition of the essential role of biomaterials in medicine and medical therapies and the essential role of the Society in advancing biomaterials education.
- Tim Topoleski and the Program Committee for organizing a great program in Boston and for his personal testimony to the power of biomaterials in human health during the opening ceremonies of the meeting. Hats off to the committee for launching our meetings app., Twitter feeds and for the late-breaking abstract sessions–these are creative aspects of the meetings and will become increasingly important as our meetings and communication technologies continue to evolve and keep our meetings relevant.

- Alan Litsky and the Publications Committee for continuing to bring us, with the leadership of Liisa Kuhn, the *Biomaterials Forum* and the electronic *Biomaterials Bulletin*, as well as working with the *Journal* editors, Dr. James Anderson and Jeremy Gilbert, and the website editor, Thomas Webster, to advocate for our journals and to make our website a valuable resource–we will be launching a new, more interactive site in the coming year. And soon the first of the *Biomaterials Books* series will be available!

- David Puleo and the Liaison Committee for continuing to develop connections between our Society and other related societies in developing special collaborative programs such as the first joint session between the US and Chinese SFBs on standards in regulatory processes, held during the meeting in Boston.

- Bruce Anneaux and Andy Doriswamy and the Devices and Materials Committee for working with and engaging our industrial members.

- Art Coury and Professor Zhang from the Chinese SFB for their outstanding leadership and dedication to planning and organizing the First US-Chinese joint program on the use of standards in the US, China and international regulatory process. This was a great feat, considering the logistical and financial challenges in working with US and China FDA organizations. I also need to thank the speakers of the session for volunteering their time, expertise and enthusiasm for the program.

We have all been supported in our efforts by an awesome and dedicated staff lead by Dan Lemyre and assisted by Leslie Clark, Rebecca Riedesel and meeting managers, Ann Mitchell, Danielle Smith and Caitlin Mariano. These individuals and other associates at our headquarters performed their jobs with the understanding our members, invited guests and meeting participants are the most important elements in this equation–thank you!

I am confident I leave the Society in good stead and in the most capable hands of incoming president Tony Mikos, a leader with a clear vision and understanding leading the Society in the best interest of our current and future members. And thanks to all of the members who have contributed and participated in creating this creative, interdisciplinary and productive society.

I will continue to work industriously to help advance the Society in its goals and mission and do whatever tasks are needed for the continued success of the Society For Biomaterials.

Sincerely,
Joel D. Bumgardner, PhD

Biomaterials Community

eCM XIV

Stem and Progenitor Cells for Musculoskeletal Regeneration
June 23-25, 2013
Davos, Switzerland.
Educational goals and objectives endorsed by ORS
http://www.ecmjournal.org/ecm_meetings/ecm_14/index.shtml

CORS2013

Eighth tri-annual Combined Meeting of Orthopaedic Research Societies (CORS 2013) will take place in the Congress Center of San Servolo, Venice, Italy.
October 13-16, 2013
http://www.cors2013.org.

2013 Award Winners

Founders Award
Robert S. Langer, ScD - Massachusetts Institute of Technology

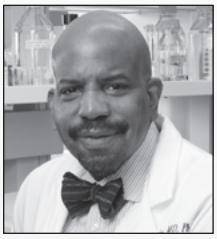
The Founders Award is based upon long-term landmark contributions to the discipline of biomaterials. As an institute professor at the Massachusetts Institute of Technology (MIT), Dr. Langer is a leader in medical sciences, drug delivery, biomaterials science and tissue engineering. His high honors include being named one of the top 100 Chemical Engineers of the 20th Century and being awarded the Charles Stark Draper Prize, the highest recognition of the US National Academy of Engineering.

C. William Hall Award
Arthur Coury, PhD – Genzyme Corporation (ret.)

The C. William Hall Award honors members who have made a significant contribution to the Society and have an outstanding record in establishing, developing, maintaining and promoting the objectives and goals of the Society. Dr. Coury is retired from Genzyme Corporation and serves as a consultant. He was elected to the National Academy of Engineering in 2009. Dr. Coury's research focuses on polymeric biomaterials for medical products such as implantable electronic devices, hydrogel-based devices and drug delivery systems. He holds more than 50 distinct patents and has been published widely in his field.

Society For Biomaterials Award for Service
C. Mauli Agrawal, PhD, PE - College of Engineering at the University of Texas at San Antonio

The award is presented to an individual, corporate or government entity who has provided significant service to the Society, by establishing, developing, maintaining and promoting its objectives and goals. Dr. Agrawal is being honored for his continuous dedication and support of the Society and his commitment to providing professional development opportunities to the SFB membership.



Technology, Innovation and Development Award
Cato T. Laurencin MD, PhD - University of Connecticut

The Technology, Innovation and Development Award recognizes an individual or team who provided key scientific and technical innovation and leadership in a novel product in which biomaterials played an important and enabling role. As Chief Executive Officer of the Institute for Clinical and Translational Science and the Director of the Institute of Regenerative Engineering at the University of Connecticut, Dr. Laurencin is a leader in materials science, biomaterials and tissue engineering.

Clemson Award for Applied Research
Elliot Lorne Chaikof, MD, PhD - Beth Israel Deaconess Medical Center

Nominees for the award must show significant utilization or application of basic science to accomplish a significant goal in the biomaterials field. As the Chairman of the Department of Surgery and Surgeon-in-Chief at the Beth Israel Deaconess Medical Center and Harvard Medical School, Dr. Chaikof has been known as one of the best vascular surgeons in the country. With laboratory research largely focused on the design of biologically-inspired materials and molecular therapeutics, Chaikof's outcomes have enabled advances in cell-based therapies, artificial organs and engineered living tissues.

Clemson Award for Basic Research
Phillip B. Messersmith, PhD - Northwestern University

To be considered for this award, nominees must have contributed to basic knowledge and understanding of the interaction of materials with biological molecules, cells and/or tissues. Dr. Messersmith has contributed to several peer-reviewed journals based on his research of the synthesis of nanocomposites, the polymer-layered silicate nanocomposites and the stress enhancement of porous coated Ti-6A1-4V implants.

Clemson Award for Contributions to the Literature
Peter X. Ma, PhD - University of Michigan

Nominees for this award must have made significant contributions to the literature on the science or technology of biomaterials. Among Dr. Ma's contributions to the field of biomaterials is the integration of scaffold design and the controlled release system. Dr. Ma and his team of researchers developed a technique on controlled-releasing nanospheres on the internal pore surface of tissue engineering scaffolds. As a result, the technology can achieve well-modulated release of biomolecules through a spatially controlled approach which has allowed manipulation of microenvironment and stem sell fate selection.

SFB Young Investigator Award
F. Kurtis Kasper, PhD - Rice University

Dr. Kasper received this award for his research achievements in the field of biomaterials. Candidates for the SFB Young Investigator Award must be within 10 years of receipt of their terminal degree (PhD or equivalent) and, if they work in an academic institution, must not be tenured at the time of nomination.

C. William Hall Scholarship Award
Benjamin Fuller – University of Minnesota Twin Cities

The C. William Hall Scholarship honors the memory of SFB's first president. It is awarded to a junior or senior undergraduate pursuing a bachelor's degree in bioengineering or a related discipline.

Student Award for Outstanding Research

The 2013 Student Awards for Outstanding Research recipients are both PhD candidates: Stephany Tzeng, Johns Hopkins University and Rameshwar Rao, University of Michigan. Student Awards for Outstanding Research are given to individuals who have demonstrated outstanding achievement in biomaterials research.

Stephany Tzeng is a graduate student at Johns Hopkins University in the PhD program of the Department of Biomedical Engineering, and she is anticipating her degree this year. Tzeng's laboratory experience includes her undergraduate time spent at Yale University. Her previous awards and honors include: 2011 National Science Foundation Graduate Research Fellow, Johns Hopkins University; 2008 Perspectives on Science Honors, Yale University; 2007 Bechman Scholar's Program Fellow, Arnold and Mabel Beckman Foundation; 2007 Dean's Fellowship in the Sciences, Yale University.

Rameshawr Rao is a graduate student at University of Michigan, in the Department of Biomedical Engineering. Rao is expected to complete the program and receive his PhD this year. His PhD research project involves creating a tailored biomaterial microenvironment for the control of cell function, using defined composites of proteins and ceramics. Rao's dedication to the field has led him to establish a student chapter of the Society For Biomaterials at the University of Michigan.

Biomaterials Education Challenge

A Biomaterials Education Challenge student describes how middle school students can design a Lego-based "bioreactor" to learn about biomaterials for tissue engineering.

The Society For Biomaterials Education and Professional Development Committee unveiled an exciting new education initiative at the 2013 SFB conference—the "Biomaterials Education Challenge." This was a student design competition where SFB student chapters around the country were encouraged to develop innovative and practical approaches to biomaterials education. In particular, SFB student chapters were challenged to develop hands-on educational modules designed for a 45 minute middle school science class period. Each educational module was designed to:

- Demonstrate a fundamental biomaterials concept.
- Describe scientific principles understandable to a middle-school audience.
- Feature hands-on components easily incorporated into typical middle school science courses.
- Use easily obtainable materials.

A team of judges evaluate a student design project during the 2013 Biomaterials Education Challenge (from left: Dr. Eben Alsberg, Dr. Michael Schwartz, and Dr. Syam Nukavarapu).

The inaugural competition included 11 entries from nine SFB student chapters, and entries were judged during a special poster session during the final day of the 2013 SFB conference in Boston. The competition's judges represented a cross-section of biomaterials educators, including innovative high school teachers, junior faculty and senior faculty at multiple universities. The judges were asked to identify winners based on their submission's potential for educational impact, with an emphasis on innovation, practicality and likelihood of widespread adoption in middle school classrooms. The competition's entries were uniformly outstanding, with clear educational goals and direct involvement of middle school educators as project "consultants." These creative projects included a Lego-based system to apply mechanical forces to biomaterials, and gelatin-based activities to demonstrate hydrogel-based tissue engineering and drug delivery. Remarkably, each of the competition entries was scored by the judges as highly likely to achieve educational impact.

After a very difficult selection process, the winning teams were announced:

- First prize ($2500 for the SFB student chapter): Case Western Reserve University: "Using Jell-O as a Teaching Tool in Middle School for Biomaterials Design and Testing." Student team: Christa Modery-Pawlowski; Julia Samorezov; Amy Wen; Sarah Gleeson. Advisors: Nicholas Ziats; Nicole Trombetta.
- Second prize ($1500): Texas A&M University: "Medicine-Delivering Hydrogels." Student team: Mary Beth Browning; Robert Moglia; Bagrat Grigoryan; Ruochong Fei. Advisors: Elizabeth Cosgriff-Hernandez; Maryam Ahmed.
- Third prize ($750): Columbia University: "Biomaterials Design for Tissue Engineering Through Hydrogels." Student team: Jon Bernhard; Maggie Boushell; Philip Chuang; Dovina Qu; Nina Sinatra. Advisors: Lauren Prentiss; Helen H. Lu.
- Fourth prize ($500): University of Memphis: "What Makes Your Braces Smart?" Student team: Ashley Parker; Heather Doty; Thien-Khoi Phung; Alex Hoban; Elizabeth Duncan. Advisors: Joel Bumgardner; Jessica Amber Jennings.

A group photo of some of the students advisors, and judges who helped make the 2013 Biomaterials EducationChallenge a success.

Congratulations to this year's winners and all of this year's outstanding competitors. SFB looks forward to broad dissemination and adoption of your educational modules. We also eagerly anticipate the second annual Biomaterials Education Challenge to be held at the 2014 SFB conference in Denver. Although the inaugural competition was a big success, we have only scratched the surface of the educational impact that is possible with these creative education modules. Stay tuned for more information about entering the 2014 Challenge!

Increasing Student Interest and Involvement

Beth Pollot, President, National Student Chapter of the Society For Biomaterials

While the everyday lives of graduate and undergraduate students may vary greatly, there is one common sentiment expressed by both—there is not enough time in the day to get everything done. With this in mind, it's hard to convince students to take time out of their already packed schedules to attend chapter meetings. However, chapters all across the country have faced this challenge head on and increased their members through three keys to success.

The first key revolves around having consistent meetings and scheduling them at least a week ahead of time. If you constantly have meetings on the third Thursday of every month instead of a random day every three or four weeks, this provides students with the opportunity to plan experiments and course work around the meetings. These meetings don't have to just be about chapter updates, either. The University of South Dakota has monthly meetings that allow members to discuss various biomaterial applications such as BioMEMS, orthopedics and nervous system disorders.

While the everyday lives of graduate and undergraduate students may vary greatly, there is one common sentiment expressed by both–there is not enough time in the day to get everything done.

The second key to successfully increasing student interest and involvement is to facilitate the chapter as a social networking platform. By providing a forum for students to interact with each other outside of the classroom and laboratory, it will establish a sense of community and camaraderie amongst those in the chapter, and they will be more likely to attend events as a way to socialize. This will also provide an environment for new students to interact with existing students, and undergraduate students will get to meet graduate students. All students would get to know their professors in a more relaxed setting. This includes having orientation events, end-of-semester activities and other events like paintball, barbeques or even happy hours. Having a variety of these events scheduled throughout the semester appeals to everyone's interests and will increase attendance at general meetings as well as outreach or career development events. Even weekly activities like intramural soccer or kickball teams will boost morale for the chapter as well as provide students with a stress-relieving activity. For instance, the University of Texas at San Antonio chapter hosts an annual fall gathering to introduce new students to existing students as well as faculty, and sponsors Laboratory Olympics with varying challenges each year. While Case Western Reserve University holds monthly general body meetings, they also host monthly happy hours that allow for students and faculty in different departments to network and build collaborations.

Students in the News

Annemarie Gallo will be graduating this May with her M.S. in Biomedical Engineering from the University of South Dakota. Her thesis is titled "Direction Specific Delivery of Dual Drugs from Coronary Stents." At USD, she was awarded a Graduate Assistantship (2011-2013) and is a student member in IEEE and the Society For Biomaterials. From the Society For Biomaterials, she was a STAR award recipient (2013 annual meeting), was the secretary/treasurer for the USD student chapter (2012-2013), is vice-chair for Biomaterials Day (May 8, 2013) and has been appointed Web Rep for the Cardiovascular Biomaterials SIG.

The third key to successfully increasing student interest and involvement in your chapter and at events is to provide career development opportunities. Students must face life after graduation and that means finding a job. By hosting events like resume building workshops, company tours and career panels with representatives of varying degrees and experiences, you can provide students the necessary tools to market themselves and their chosen career path. It can be especially helpful to invite previous graduates from your chapter back to meet current students. This allows students

to see the potential of their degrees and connects alumni back to the chapter. If you can provide your members with the tools and opportunities to excel in their chosen career path, you are opening up unlimited possibilities. These events are easy to organize, as most local companies are usually happy to give presentations to local institutions since this may foster potential collaborative research as well as new hires. Columbia University's chapter partnered with other University organizations to hold an industry panel with six representatives coming from varying disciplines and levels of education in order to answer student questions about getting a job in their field.

Columbia University industry panelists and student organizers

The University of California, Los Angeles, sponsored a seminar talk with Lynne Jones, PhD, from John Hopkins, entitled "Careers in the Biomedical Field." The Texas A&M chapter is even going to neighboring cities like San Antonio and Houston to expose their members to post-graduate opportunities and cutting-edge biomaterials product development. Vanderbilt University and the University of Memphis student chapters have incorporated career development into their Biomaterials Day in March by hosting a networking lunch with presentations by industry and academia representatives.

Professor Lynne Jones, third from left, speaks to the UCLA Student Chapter about careers in the biomedical field

These three keys can help increase student interest and involvement in any chapter. Also, they are easy to implement and apply to a variety of students. With limited time, these activities will attract students to take a much-needed break and foster the mission and vision statements of each student chapter. People are the primary strength of any organization and student organizations are no different, which is why increasing student involvement is vital to the success of the organization.

Vanderbilt Student Chapter

Society For Biomaterials
15000 Commerce Parkway, Suite C
Mt. Laurel, NJ 08054
Phone: 856-439-0826
fax: 856-439-0525
email: info@biomaterials.org

Special Interest Group Application

Please note: You must be a member of SFB to join a SIG

First Name: _____ Last Name: _____ Suffix: _____

Highest Degree: _____ Title: _____

Company/Affiliation: _____

Department: _____

Address: _____

City, State, ZIP, Country: _____

Telephone: _____ Fax: _____

E-mail: _____

Special Interest Groups (Optional)

*Each Special Interest Group is $10 per year (**free for Student Members**)*

- ☐ Biomaterials & Medical Products Commercialization
- ☐ Biomaterials Education
- ☐ Cardiovascular Biomaterials
- ☐ Dental/Craniofacial Biomaterials
- ☐ Drug Delivery
- ☐ Engineering Cells & Their Microenvironments
- ☐ Implant Pathology
- ☐ Ophthalmic Biomaterials
- ☐ Orthopedic Biomaterials
- ☐ Protein & Cells at Interfaces
- ☐ Surface Characterization & Modifications
- ☐ Tissue Engineering
- ☐ Nano Materials

TOTAL AMOUNT DUE $ _____

☐ **Check Enclosed** *Checks must be in U. S. Dollars drawn on a U.S. bank and made payable to the Society For Biomaterials.*

☐ **MasterCard** ☐ **Visa** ☐ **American Express** *(Credit Card Payments may be sent via facsimile to +1 (856) 439-0525)*

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Utilizing Hydrophobic/Hydrophilic Interactions in Biomaterials: Old Dog, New Tricks!

by Sumona Sarkar, Ph.D., National Institute of Standards and Technology

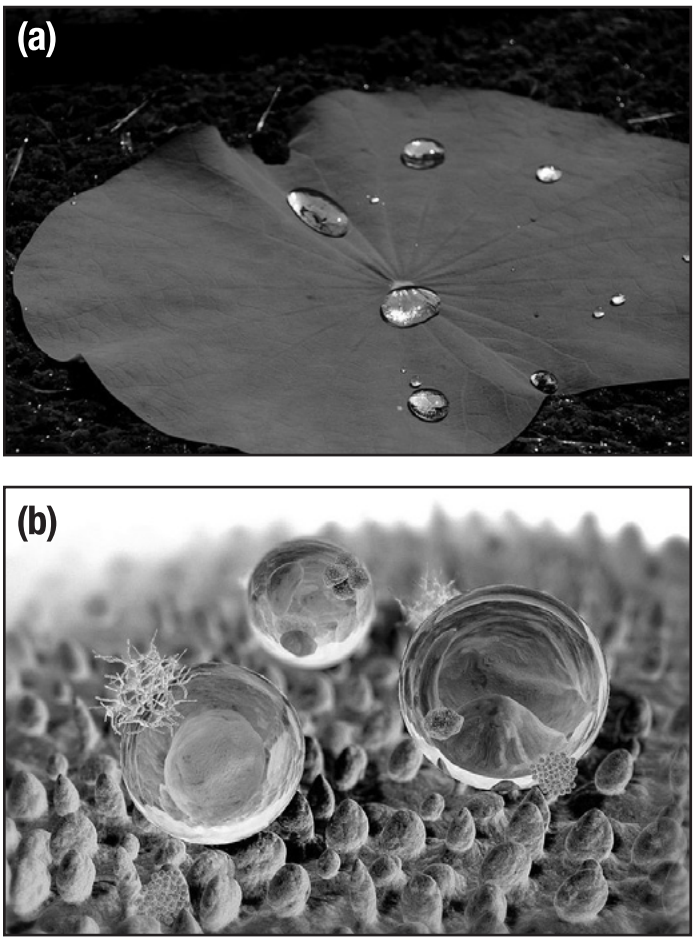

Figure 1: The Lotus Effect (a) The lotus leaf with self-cleaning surface properties (© GJ Bulte/Wikimedia Commons/CC-BY-SA-3.0). (b) Graphic illustration of the lotus leaf surface with hydrophobicity arising from nano-topography and a waxy chemical residue. Water droplets easily roll off of the leaf surface carrying away debris (© William Thielicke/ Wikimedia Commons/CC-BY-SA-3.0) (Wang, 2011).

Nature's incorporation of wettability properties in the lotus leaf [1] is a prime example of the functionality of hydrophobicity/ hydrophilicity in biological systems. The lotus leaf has developed remarkable superhydrophobic properties, which allow self-cleaning of the leaf surface. Both micro- and nano-scale topography, as well as a waxy residue at the surface of the lotus leaf, contribute to a high water contact angle (WAC) around 161°, allowing rain drops on the leaf surface roll off easily, carrying debris away with the droplet[1]. As demonstrated by the lotus leaf, both topographical features and surface chemistry contribute to the overall wettability of a material. This "lotus effect" has inspired the development of novel materials which incorporate several length scales of topography and chemistry in order to impart superhydrophobic properties for applications in the textiles and coatings industries[1]. Biomaterials scientists have developed new materials and surfaces by utilizing both hydrophobic and hydrophilic interactions. Modulating the wettability of biomaterials surfaces has allowed for the control of cell attachment, proliferation and spreading[2,3]. The hydrophobicity/hydrophilicity of surfaces impact the interactions of proteins with the surface, changing the environment presented to the cell by altering mass, distribution, and conformation of adsorbed proteins[4,5]. Wettability however, is often strongly associated with other surface features including topography and chemistry, making it difficult to draw conclusions about the direct effect of wettability on cell response and protein interactions.

In a recent study published in *Biomaterials* by Park and Schwartz et al.[6], a novel fabrication technique was developed to vary surface wettability while controlling surface features such as chemistry and topography. In this study, microtextured titanium discs were oxygen plasma treated then aged from 0 to 24 h in order to systematically decrease available reactive oxygen species. Surfaces were then coated with chitosan, resulting in surface wettabilities that decreased with increasing aging time. This surface modification technique resulted in surfaces with similar roughness and chemistry but varied water contact angle (ranging from 81° to 15°)[6]. MG63 Osteoblasts cultured on these substrates demonstrated increased osteogenesis with increased surface wettability and interestingly, integrin expression was also dependent on wettability. Novel materials which allow for the systematic investigation of individual surface features will allow for the elucidation of mechanisms that control cell-surface interactions.

As *in vitro* cell culture has transitioned to 3-D scaffolds, wettability has played a new role. A major drawback of synthetic 3-D scaffolds is they are largely hydrophobic, hindering cell seeding and nutrient diffusion. Altering scaffold wetting properties has become an important tool for promoting desirable cell seeding and cell responses[7]. Increasing the hydrophilicity of synthetic scaffolds has been achieved via techniques such as surface hydrolysis, plasma treatment, and surface grafting/coating with hydrophilic polymers. These treatments result in more even distribution of cell seeding as well as enhanced media and nutrient diffusion through the porous scaffolds[7].

Another major advance in the utilization of hydrophobic/hydrophilic interactions is in the field of cell-patterning. Microcontact printing (μCP), a widely used technique for cell-patterning, was pioneered by the Whitesides group almost two decades ago[8,9]. This technique utilizes self assembled monolayers (SAMs) patterned with a hydrophobic, protein absorptive region, separated by regions terminated in groups that resist protein adsorption. Patterning subsequently leads to preferential cell attachment on the protein adsorbed regions. The technique of μCP is now being applied in novel ways in order to elicit desired cell function, or in the case of stem cells, to promote lack of function. In a paper published this year in *Biomaterials* by Zhang and Kilian[10], μCP was used to pattern cell micro-islands which restrict cell shape and subsequent cytoskeletal tension. Human mesenchymal stem cells (hMSCs) patterned in these islands were demonstrated to have higher expression of pluripotent transcription factors compared to those cells in standard culture conditions[10]. hMSCs were also able to retain their multipotency to differentiate down the osteogenic and adipogenic lineages after release from the micro-island cultures. This study highlights the importance of cell patterning in the development of microengineered substrates to preserve stem cell phenotype with implications for both cell culture and regenerative medicine[10].

Novel methods have also been developed utilizing hydrophobic/hydrophilic interactions to pattern substrates. In research conducted by the Levkin Lab at the Karlsruhe Institute of Technology in Germany, cell and droplet microarrays are being developed utilizing superhydrophilic cell adhesive islands and superhydrophobic cell-free regions[11,12]. To create substrates with superhydrophobic/superhydrophilic patterns, superhydrophilic (water contact angle of ~0°) nanoporous film are first synthesized by photopolymerization[12]. The films are then photo-patterned with a superhydrophobic brush polymer layer[12]. Superhydrophobic regions of the pattern have water contact angles as large as 165°, which repel water droplets, thus isolating aqueous solutions to the hydrophilic regions of the pattern[11]. Various cell lines have been successfully cultured on these patterned substrates in both 2-D (directly on the nanopourous substrate) and 3-D (within hydrogel micropads) environments providing a versatile tool for cell-microarray and high throughput analyses[11,12].

In addition to patterning droplets for cell-microarray analysis, researchers in the Khademhosseini Group at Harvard University, have recently published a method to use designer hydrophilic regions to regulate droplet shape for controlled surface patterning of droplets and gradients[13]. In this study, three methods (mask and spray method, coated cutouts method and, microcontact printing for smaller features) were used to pattern hydrophobic and hydrophilic regions onto a substrate in specific designs to control droplet shape. Surface hydrophobic/hydrophilic boundaries were demonstrated to control droplet shape as well as the depth profile of the droplet across the macro/micro-patterned area[13]. For example, in a spiral-shaped water droplet, droplet depth increases as the spiral is followed from the center of the spiral outward[13]. When microparticles or cells were suspended in the droplet, the depth profile of the droplet caused differences in particle sedimentation, resulting in microparticles[13] and cells patterned on the surface with controlled 2D spatial variations in surface concentration. Utilization of these unique properties of droplet formation and particle sedimentation for cell patterning can have implications in regulating cell proliferation, attachment and morphology while spatial patterning of microparticles can be very useful in directing cell migration and modulating local surface morphology[13].

Hydrophobic/hydrophilic interactions have evolved in nature to provide specific functions, and over the past decades, researchers have also worked to understand and employ this material property. The use of surface wettability properties has allowed for simple manipulation of the cell-material interface resulting in elegant solutions to difficult problems and the development of new platform culture systems. The property of wettability however, is strongly tied to surface chemistry and topography therefore, as new material systems are developed the synergistic effects of these properties at various length scales will need to be understood. There is great potential to utilize hydrophobic/hydrophilic properties to tailor cell response as has been seen in several 2D culture systems. As cultures transition to the 3D environment, scaffold wettability has already been demonstrated to play a role in initial cell seeding and nutrient diffusion, but it may also provide a convenient tool to control drug/growth factor release, direct cell migration and modulate cell function in 3D. Patterning of surface wettability may also play a large role in emerging fields such as *in vitro* lab-on-a-chip and organ-on-a-chip designs. As new materials, chemistries and techniques are developed, the possibilities of the impact of this seemingly minor material property may surprise us all.

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Updates from the Special Interest Groups – Notes from the Boston Meeting

Each Special Interest Group (SIG) held its own meeting during the Society's conference in Boston. Following are brief recaps of some of the meeting notes:

Biomaterials Education (ED) SIG

SIG members proposed meeting ideas for 2014 on issues such as designing a meaningful lab, what is consensus for core course content for a biomaterials course in the framework of biomedical engineering, what is needed in undergraduate-only courses and teaching the teachers (high school level). Development of outreach programs or website information for teachers was discussed. Reaching and involving Student Chapters, the Biomaterials Challenge, possible career awards for younger faculty and several other brief items were covered.

Biomaterials and Medical Products Commercialization (BMPC) SIG

Topics discussed included recent changes in US patent law, "hot button" items such as nanotechnology, NIH funding of clinical studies, product liability, sequestration's impact on government research funding and non-USA commercialization. A drawing was held for four medical products issue-related books.

Cardiovascular Biomaterials (CVB) SIG

SIG members talked about session ideas to propose for 2014, the CVB website and submissions for the *Biomaterials Forum*. Poster presenters were judged by the officers plus three other judges, and one was selected to receive an award. Holding cooperative sessions with other SIGs is a goal for 2014.

Dental/Craniofacial Biomaterials (Dental) SIG

The members agreed to organize a session on biomaterials for next year's AADR meeting in order to increase the presence of the Dental SIG and SFB at this meeting. A lot of biomaterials scientists attend AADR. The SIG is seeking students to help build a Dental SIG website. Sessions on dental materials and composites were discussed for SFB's meeting next year.

Drug Delivery (DD) SIG

This year water bottles with the DD logo imprinted were successfully used to attract new members. Many new sign-ups were received. A social event will be planned for 2014, the expanded use of social media (DD web page, LinkedIn, Facebook, Twitter) will highlight SIG activities and match employers, post-docs and others. Ways to encourage intra-SIG sponsored meeting sessions were discussed.

Engineering Cells and Their Microenvironments (ECTM) SIG

Having recently changed its name from the Cell and Organ Therapies SIG, the Engineering Cells and Their Microenvironments (ECTM) SIG held a highly productive meeting in Boston. Discussion at the meeting focused on building on the success of the general sessions sponsored by ECTM in Boston and on continuing to foster the work and careers of researchers working in ECTM areas. In the coming months, the ECTM SIG officers will work with the SIG members to develop plans to increase recognition of students working in ECTM areas through sponsored awards and bring together ECTM researchers at informal social events.

(Continued on next page)

Hydrophobic/Hydrophilic Interactions in Biomaterials

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SIG Updates

(Continued from previous page)

Implant Pathology (IP) SIG

Discussion items included ways to make the annual SIG meeting more popular, a potential SIG name change, the use of the IP SIG budget and ideas for the 2014 SFB annual meeting. The name change issue will be pursued further. An online journal club to be held between meetings was suggested.

Nanomaterials (NANO) SIG

Members of the Nanomaterials SIG discussed ways to improve the presence of the SIG on the web and in the community, including outreach to Nano Centers across the USA. Mechanisms to encourage submission of "Biomaterials of the Month" and other articles, including prizes, were agreed upon. Ways to increase the breadth of nanomaterials research beyond nanoparticles were offered, with agreement on how to strengthen future programming via Nanomaterials SIG-led symposium ideas. Student and web representatives were nominated. Finally, planning for the 2014 meeting was discussed.

Ophthalmic Biomaterials (OPH) SIG

The Ophthalmic Biomaterials SIG meeting was attended by 22 of the 65 active members. The SIG has been active this past year and coordinated two symposia sessions at the SFB 2012 (New Orleans) meeting and two symposia sessions at the SFB 2013 (Boston) meeting. All sessions were well attended and provided a platform for presenting and discussing advances in ophthalmic biomaterials and opportunities for collaborations. The SIG representatives will have a conference call on a frequent basis to ensure the objectives of the SIG are met.

Orthopaedic Biomaterials (ORT) SIG

Topics discussed included improving service to SIG members through social media, developing closer ties with other societies via joint sessions, creating international, industry and medical rep positions within the SIG and session ideas for 2014.

Proteins and Cells at Interfaces (PCI) SIG

It was decided to create a PCI Twitter account and Facebook page to reach out to members.

Surface Characterization and Modification (SCM) SIG

Many ideas for the 2014 meeting were discussed, as were ways to bring in new SCM members. The SIG continues to produce student resumes on CDs, which are given out to industry as a way to help the students find positions. Plans were made to conduct a virtual meeting via webinar sometime in the next three months.

Tissue Engineering (TE) SIG

The group discussed specific ideas for increasing the representation of clinicians at meetings and within the SFB. It was proposed to organize a joint panel of clinicians and tissue engineering researchers at next year's SFB meeting. The group also solicited innovative proposals for attracting new members to the SIG and requested that ideas be submitted to the officers within the next month.

SIGs Announce 2013 Poster Awards of Merit

To encourage excellence in presentations and recognize the effort required to create a quality poster for the annual meeting, several SIGs created poster awards to complement the STAR Awards. Poster presentations were scored on a combination of factors, including the SFB abstract review score, the poster's appearance and design elements, the presenter's understanding of the subject and how it was conveyed orally and the research content and overall quality.

This year's Poster Award of Merit recipients are:

Cardiovascular Biomaterials SIG

- Samantha Noel (Ecole Polytechnique de Montreal)

Dental/Craniofacial Biomaterials SIG

- Bryan Orellana (University of Kentucky)
- Sarita Shah (Rice University)

Orthopaedic Biomaterials SIG

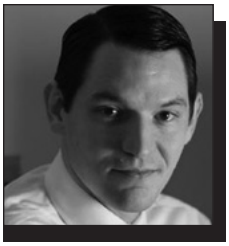
- Amanda Clark (University of Kentucky)
- Akhilesh Gaharwar (Massachusetts Institute of Technology)
- Maryam Nabiyouni (University of Toledo)
- Amir Torbati (Syracuse University)

Tissue Engineering SIG

- Lin Lin (Case Western Reserve University)
- Pauline Luong (Texas A&M University)
- Yukiko Matsunaga (The University of Tokyo)
- Jennifer Robinson (Texas A&M University)

From the New SIG Representative

by Steve Little, Chairman and CNG Faculty Fellow, Department of Chemical Engineering, University of Pittsburgh



I consider it a great honor to have been elected by the Special Interest Group (SIG) Chairs to become the next Representative of the SIGs on the Board of Directors. I have served alongside so many wonderful people who made my own SIG feel like home, and I hope to do the same for the next generation of members. But, of all the people I have had the privilege to serve alongside, the person I most highly respect is our outgoing SIG Representative, Jeffrey Schwartz. Not only did Jeff serve as a mentor to me in my own role as SIG Chair, but he also did a remarkable job in his primary mission of increasing communication between the SIGs and the Society's administration and leadership.
To say I have some big shoes to fill would be a sizable understatement. It's my hope, with the help of Jeff and all of the newly elected leaders of the SIGs, I can maintain the degree of excellence in service to the Society so apparent with our previous SIG Representatives.

On that note, I would like to briefly mention a few of the items on my agenda for the next two years. I am most excited about passionately supporting the ambitions of the newly elected leaders of each SIG. These new officers will have aggressive goals to increase membership in their respective SIGs and to offer a greater degree of value for those new (and existing) members. This may take the form of opportunities to reach out to new members in new and innovative ways, a greater level of exposure for SIGs at the Annual Meetings and special SIG events. I am also committed to continuing the mission of our excellent outgoing SIG Representative in the area of communication by continuing with the monthly *SIGnal e-newsletters*. I'd also like to take the next step in increasing communication with the leadership of each SIG through more regular, personal conference calls so their interests can be properly represented in the Board of Directors' decision-making process.

In addition, I'm willing to bet you've heard of the exciting changes on the horizon for our Society's website, and, correspondingly, the websites for each of the SIGs. I see this as a fantastic opportunity for enhanced communication between the elected officials of each SIG and their constituency. As just a few examples, enhancements can (and should) be made in both social media and web-based functionality to allow individuals to sign up (and pay for) special SIG events and even SIG membership, thereby establishing a new tool at the disposal of the Chairmen for meeting recruitment goals. Finally, I see great opportunities in the area of SIG-exclusive special events at the Annual Meetings. I have personally had the privilege (along with the other excellent leaders in my SIG) to organize a series of these special events. To give a few examples, our SIG was able to successfully host events such as a Luau in Disney World and a SIG-exclusive Riverboat Cruise in New Orleans. These events are an extremely wise (and fun) investment of SIG funds to promote membership and provide real value to the members of the SIGs through enhanced interactions (especially for young members). Yet not all SIGs have had the resources to host such events. For SIGs without sufficient funds to invest in such an event, we will attempt to pair SIGs (small/small or small/large) so these events are within reach. Furthermore, it will be my personal mission to incentivize the SIG-elected officials who are diligently contributing to *Forum* articles, providing Biomaterials of the Month and increasing their membership by making sure these leaders have the resources they need to make the success of their SIG match the size of their ambition.

It's always been my opinion that our SIGs are a truly unique benefit of membership in the Society For Biomaterials, offering a way for participants to form meaningful connections and contribute in meaningful ways. The effectiveness and influence of the SIGs has been increasing dramatically of late, and they will inevitably continue to do so because of the contributions of the SIG membership and their elected leaders. If I can simply encourage the ambitions of these individuals while staying out of their way as much as possible, I can only imagine what the SIGs will grow to become in 2015 and beyond.

Industry News

BioDigital Systems (New York) has developed an animation and visualization system providing a 3-D view of the human body so detailed it can be used to model a device or implant and its function within the human anatomy. The company is working with **Medtronic** on a project dubbed CyberHeart using real human data to model the heart surface and attach real motion data to the 3-D models. The outcome was the representation of a very realistic beating virtual heart. The advantage of the visualization system is it allows device makers to look deeper into the body and see things that might not necessarily appear on MRI or CT scans. BioDigital also offers a service where it can lay a virtual rendition of a device into a virtual body to demonstrate how the device would be positioned and how it could affect surrounding structures. The company can even render the entire implant process from beginning to end. More than 5000 peer-reviewed models of male and female anatomy are available online through biodigitalhuman.com, an online tool offering detailed 3-D views of the human body that enables users to add and remove layers and conditions.

The government's Strategy 2020 aims to make up for lost time by pouring significant resources into the device and pharmaceutical sectors and aims to increase the market share of national medical device manufacturing from the current 18 percent to 40 percent.

If **Russia** is not currently on your radar as a medtech market, it will be soon. Currently valued at $6.4 billion, the medtech market is projected to grow 13.5 percent annually to become the world's sixth largest by 2020. It is a sophisticated, premium-price market with enormous potential for medical device manufacturers. The healthcare sector languished for many years, and it is the last major public sector to undergo reform in Russia. The government's **Strategy 2020** aims to make up for lost time by pouring significant resources into the device and pharmaceutical sectors and aims to increase the market share of national medical device manufacturing from the current 18 percent to 40 percent.

Medtronic has paid **Edwards Lifesciences** $83.6 million as part of a settlement for a multi-year patent spat. Information about the settlement was posted in a filing to the United States Securities and Exchange Commission. In April 2010, a jury awarded Edwards Lifesciences $83.6 million plus accrued interest due to copyright infringement concerns over Medtronic's **CoreValve** system. CoreValve was purchased in 2009 by Medtronic for $700 million. Both CoreValve and Edwards Lifesciences filed lawsuits in 2007 alleging the other engaged in patent infringement. In November of 2012, the United States Court of Appeals for the Federal Circuit upheld a previous ruling by Judge Gregory Sleet at the United States District Court of Delaware that Edwards Lifesciences' patent is valid and was infringed upon by CoreValve and then Medtronic. If Medtronic's CoreValve heart implant is blocked from the United States market, Edwards Lifesciences' **Sapien** health valve implant will be the only device on the market approved for transcanteher aortic valve implantation.

Crescent Diagnostics (Dublin, Ireland) will launch its **Bone Quality Test** (BQT), which measures keratin levels in nail clippings as a surrogate marker for collagen, an indicator of bone quality. The consumer-to-lab kit initially will be available in Ireland and the United Kingdom, with other European markets, notably Germany and Sweden, to follow. The test will allow people to assess their risk of contracting osteoporosis in a simple, cost-effective way, and is not designed to replace traditional tests, such as DXA. DXA screenings are costly and conducted in clinical settings, and BQT is marketed directly to consumers who could then determine if they are at risk, and, if so, seek further medical attention. The test itself takes about four minutes of lab time, and the cost to the consumer will be in the neighborhood of £39 (approximately $60). A DXA scan, by contrast, requires the services of a clinician, can take up to one hour, and costs around £200 ($300). In the United States, more than 10 million people have been diagnosed with osteoporosis, and 34 million more are at risk of developing it.

Covidien (Mansfield, Mass.) announced its biologic tissue mesh, **Permacol**, for hernia repair product lines had fallen short of its financial expectations. The Permacol biologic mesh is a specialized porcine dermal collagen implant designed for abdominal wall and hernia repair. The company originally acquired the Permacol business from **Tissue Science Labs**, a medical device manufacturer based in Andover, Mass. Covidien purchased the company in 2008 for an estimated $80 million.

(Continued on page 20)

(Continued from page 19)

If **Mobile World Congress 2013**, held in Barcelona February 25-28 2013, made one thing clear, it is that soon we will all be doctors to some degree. Wireless technologies such as Bluetooth Smart are increasingly adding a consumer element to healthcare. Over the past few years, we have already seen an increase in wireless sports and fitness monitoring devices; now, this technology is entering the medical realm as well. A pavilion was dedicated to mobile healthcare devices at Mobile World. In this pavilion, consumer healthcare sensors ranging from scales to blood pressure meters and more advanced monitoring systems were on display. These devices can help doctors get a more long-term overview of a patient's condition, rather than a momentary glance, greatly improving diagnostic effectiveness. Patients gain access to accurate, easy-to-use tools that allow them to monitor their health and identify anomalies. The diagnosis itself should always remain the doctor's responsibility.

Cardiac Designs, a medical device manufacturer based in Utah, received 510(k) clearance from the United States Food and Drug Administration for its iPhone ECG monitor. Many consumers have an increasing interest in recording their own heart rhythm data. While the regulatory win may benefit these consumers, the 510(k) clearance comes with an unusual caveat. To view the raw waveform data captured from their hearts, patients will be required to obtain a prescription from a physician. One of the company's rivals, **AliveCor**, is attempting to overturn the raw data restriction that plagues Cardiac Devices' iPhone heart monitor. Last week, **AliveCor's AliveECG** heart monitor was used by a physician during a flight to diagnose a patient experiencing abnormal heart rhythms. In 2011, the device was used during a flight for a rapid diagnosis of a patient experiencing a heart attack. The AliveCor device has not received over-the-counter clearance from the FDA. Instead, a physician must prescribe the heart monitor for use by a patient. The company is hoping for OTC approval in the later half of 2013.

Gastrointestinal devices treat a multitude of disorders including esophageal cancer, stomach cancer, colon cancer and Crohn's disease. Similar to the factors propelling the device market overall, use of gastrointestinal devices is increasing because of rapid advancements in technology, an aging global population and a desire for minimally invasive procedures. The US is the largest market for these devices, accounting for 39 percent of the global sales in 2011. In 2013, this figure will grow to $21.8 billion, according to Visiongain, a UK-based business intelligence firm. Gastrointestinal endoscopy devices will continue to be the largest segment of the gastrointestinal devices market overall and that sub-segment will grow to $6.6 billion in 2017 and $11 billion in 2023. Key players in the space are **Ethicon-Endo Surgery** (part of **Johnson and Johnson**), **Olympus, Boston Scientific**, **Coloplast, Given Imaging, CONMED** and **Covidien**.

The business outlook for Europe's medical technology industry is on the mend, according to a just-released survey of top-level industry decision makers, but pricing pressure from the procurement environment and aggressive competitors is a growing concern. When asked how they viewed business prospects in Europe's medtech space for 2013, about 40 percent of the 60 industry executives surveyed said they expected this year to be better than 2012. Another 40 percent forecast a stable business outlook, while only 20 percent were pessimistic. By and large, overall growth in the medtech sector is expected to largely mirror 2012 results, according to the **MedTech Barometer** 2013 report unveiled at the **Simon-Kucher** annual **European MedTech Strategy Forum** March 20 in Amsterdam.

New Online Journal: *Forum for Dental Student Research and Innovation*

The first issue of the new online research journal, *Forum for Dental Student Research and Innovation (FDSRI)* is now available at http://www.fdsri.com. Two years ago, this journal was just a gleam in the eyes of a few people at University at Buffalo's School of Dental Medicine and the publisher's company (AEGIS Communications). Anne E. Meyer, Ph.D., Associate Dean for Research at the School of Dental Medicine, University at Buffalo, is the founding Editor-in-Chief. She invites you to submit research articles and other types of articles from your clinics and labs. Visit the above URL for more information about the purpose and scope of the journal, as well as the content the founding editorial board hopes to share around the world. The founding editorial board includes leading dental faculty from Brazil, China, India, Israel, Japan, Saudi Arabia, South Africa, Sweden and the U.S. In addition to manuscripts, Meyer invites comments and recommendations for improving the website and the journal. Please bring the journal to the attention of students and colleagues interested in research and clinical applications of dental materials.

Biomaterials in Biomedical Design Classes: Balancing the Established with the New

Jan P. Stegemann,
Education News
Contributing Editor

Medical product design is becoming an increasingly important topic in a number of engineering disciplines. Most biomedical, chemical and mechanical engineering departments require their students to participate in a capstone design experience, often in their senior year. These experiences have become increasingly varied and projects with a medical or biological focus are popular with students in a variety of fields. In particular, these experiences often involve design of medical devices for use in western clinics, and, increasingly, these courses are also developing technologies aimed at under-resourced environments and developing nations. Clearly, biomaterials selection is an important component in these biomedical design experiences, and they influence both the process and the product of design.

One issue that arises in design experiences is existing, established and currently used biomaterials often present the most obvious and easily accessible choice for student teams when they are selecting materials for a new device design.

Biomaterials and biomaterials science courses are varied in their content and format. Some classes approach the topic from a fundamental perspective and provide a materials science-based foundation for students to understand the structure and function of a variety of classes of biomaterials. In some cases these classes also stress "biomaterials design" and the development of new biomaterials through a rational process of combining materials science and biological principles. Other classes have an applied approach, stressing the functional properties of existing biomaterials and their use in medical products. These courses often stress empirical knowledge and industrial experience with the materials as well as selection of materials for particular applications. Of course, many biomaterials curricula employ a mix of these approaches to help students understand both the fundamental and applied aspects of the field. However, while many programs provide their students with a fairly thorough biomaterials education, this knowledge is often not well integrated into the capstone design classes.

One issue that arises in design experiences is existing, established and currently used biomaterials often present the most obvious and easily accessible choice for student teams when they are selecting materials for a new device design. This path makes sense and is even encouraged in many classes, since the medical device industry now has a stable of well-characterized materials with a "track record" of use in medical applications. There is an understandable view that sticking to established materials will simplify the product development process and lead to quicker approval and adoption in the market. However, the knowledge and creativity of our students is unfortunately held in check by the pressure to stick to conventional and established materials.

A main constraint preventing a more exploratory approach to biomaterials selection is the rigorous regulatory process that medical devices must pass through in order to become commercial products. In the United States, the federal Food and Drug Administration process requires extensive materials characterization and testing in order to allow the use of new materials as constituents of medical devices. These tests focus on toxicity and biocompatibility of materials, with an understandable emphasis on safety in both the short- and long-term. Introduction of a new biomaterial into a product makes it less likely that even a relatively simple device will be granted regulatory clearance through the 510(k) mechanism and complicates the process of applying for premarket approval for implantable and life-sustaining devices.

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Biomedical Design Class

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In addition, conventional biomaterials have the advantage that they are more familiar to the people and companies who established the medical device industry. In many cases, the patents on the original materials expired decades ago, allowing their broad use without risk of infringement. Similarly, the fabrication methods for conventional materials are well established, which allows companies to design for manufacturing and streamline their product verification and production processes. Sterilization, packaging and shipping are also critical considerations when developing a new medical product, and again established materials have the advantage of being well vetted.

However, few would argue the limited set of biomaterials now most commonly used in medical devices is ideal. Clearly there is a need for new materials that outperform our current options in safety, function and price. The science behind our field has progressed rapidly in the past few decades, both in our understanding of materials across multiple length scales and in our knowledge of the biological and physiological processes important to their acceptance and function. Our students often learn about these exciting advances in their biomaterials classes, but less often do they have the opportunity to put them into practice. Research labs around the world have demonstrated remarkable control over cell function and integration into physiological systems using a variety of rationally designed and multifunctional materials. However, translating these new technologies to the clinic has proven to be more problematic, in part because of the relative inertia that exists in biomaterials selection in the medical device industry.

It would seem the undergraduate and graduate curricula are appropriate and promising places to allow students to be more creative in their use of new biomaterials, while also taking into consideration the needs of product development and commercialization. The challenge is to provide an appropriate balance between the proven performance of established conventional materials and the potential advantages of more novel and physiologically functional biomaterials. This balance must also recognize the need of the medical device industry for well-trained graduates with an understanding of the current state of the art and the constraints in product development. But it also leaves room for students to explore and innovate in ways that will hopefully shape our industry in the future. To this end, there is a clear need for better integration of the biomaterials and design curricula. A key issue in both cases is to make it not just possible but attractive for students to apply more of their biomaterials knowledge to the design process. Admittedly, most senior design experiences are already very full and challenging, but biomaterials are at the core of many medical technologies. Efforts in academia to provide a stronger connection between biomaterials and design should lead to more innovation in industry. As always, I am interested in hearing from other scientists and educators about their experiences on this topic.

Education Quote of the Quarter

"Much education today is monumentally ineffective. All too often we are giving young people cut flowers when we should be teaching them to grow their own plants."
–John W. Gardner

Members in the News

Nicholas P. Ziats, Ph.D., Society Business and Member News Contributing Editor

This will be my final contribution as your Member-at-Large for the past year, and I strongly encourage our members to send newsworthy items to the newly elected Member-at-Large, Jan Stegemann. It has been my pleasure to have served you and the Society this past year. Here are some outstanding achievements by some of our members.

C. Mauli Agrawal, Ph.D., P.E., has recently been named Vice President of Research at the University of Texas, San Antonio. Dr. Agrawal is a Past President of the Society For Biomaterials.

Barbara D. Boyan, Ph.D., Dean of the School of Engineering at Virginia Commonwealth University, announced **L. Franklin Bost, M.B.A., I.D.S.A.,** was named as Associate Dean of the VCU School of Engineering.

Arthur J. Coury, Ph.D., will be honored as a member of the "Outstanding Alumni" of the University of Minnesota in May of this year. Dr. Coury is a Past President of the Society.

David Grainger, Ph.D., Distinguished Professor and Chair, Pharmaceutics and Pharmaceutical Chemistry, University of Utah, is the 2013 recipient of the Excellence in Surface Science Award, awarded by the Surfaces in Biomaterials Foundation. Dr. Grainger will present his award address at the Biointerfaces meeting October 9 at the Sofitel in Minneapolis.

Thomas Horbett, Ph.D., University of Washington, writes that even though he retired a few years ago, he continues some biomaterials activities, including being the lead instructor in their biomaterials course each fall, having been rehired, part-time, by his university for that purpose. He also continues being a manuscript reviewer for several journals including *JBMR*. He writes that the most notable activity for himself and members of SFB is that a third Proteins at Interfaces Symposium series book was completed recently. Here is some info about the book: *Proteins at Interfaces III. State of the Art - ACS Symposium Series* (ACS Publications, ISBN-9780841227965). The book was based on a symposium held at America Chemical Society's March 2012 meeting in San Diego. **Drs. Willem Norde** and **John L. Brash**, from McMaster University, were the editors and also co-wrote the Introductory Overview chapter. This book will be of interest to many SFB Members.

Rahim Jindani, Ph.D., North Carolina State University, writes that the work of his colleague, **Chirag Gajjar** (a doctoral student working with Dr. Marian McCord) on smart bandages coated with tetraethyl orthosilicate for stopping blood flow or hemostasis, was recently published in *Popular Mechanics*.

Robert. S. Langer, Sc.D., recently received Israel's prestigious Wolf Prize this year. Dr. Langer was honored for his innovations that "have had a profound impact on medicine."

Robert Latour, Ph.D. from the Department of Bioengineering at Clemson University, is presently spending a sabbatical year at King's College, University of London, where he is working with Dr. Chris Lorenz, Department of Physics, to develop new modules for the LAMMPS molecular simulation program. The new LAMMPS modules are being specifically designed to perform molecular simulations of the interactions of biomolecules with synthetic materials (e.g., protein, DNA, or polysaccharide-surface interactions, or the simulation of hybrid bioconjugate systems incorporating biomolecules within a material matrix). LAMMPS, which stands for Large-scale Atomic/Molecular Massively Parallel Simulator, is an advanced molecular simulation package freely available from the Sandia National Laboratories website: http://lammps.sandia.gov/. It is anticipated the developed new modules for LAMMPS will be available for use by other interested parties by the end of this year. Investigators interested in using this molecular simulation program and the new modules that should soon be available should contact Dr. Latour at latourr@clemson.edu.

Grayson W. (Bill) Marshall, D.D.S., M.P.H., Ph.D., was recently named a Distinguished Professor Emeritus. Dr. Marshall is Chair of the Division of Biomaterials and Bioengineering at the University of California San Francisco. In addition, Dr. Marshall was awarded an Honorary Doctorate from Malmo University in Sweden 2012. Dr. Marshall also holds appointments in the UC Berkeley-UCSF Joint Bioengineering Graduate Program, the UCSF Oral and Craniofacial Sciences Graduate Program, the Broad Center for Stem Cell Research and Regenerative Medicine, the Craniofacial and Mesenchymal Biology Program and is a Guest Scientist at Lawrence Berkeley National Laboratory and the Stanford Linear Accelerator Center.

Nicholas Peppas, Ph.D., the Fletcher S. Pratt Chair of Chemical Engineering, Biomedical Engineering and Pharmacy at the University of Texas at Austin, recently received the National Academy of Engineering's Founder's Award, presented to an individual who has had an extraordinary impact on the engineering profession. The Academy says Dr. Peppas will receive the Founders Award for "…contributions to biomedical and drug delivery applications of polymer networks and hydrogels and for leadership in the bioengineering community." The award recognizes outstanding professional, educational and personal achievements to the benefit of society, and it includes a commemorative medal.

R. Geoff Richards, Ph.D., Director AO Research Institute, Davos, Switzerland, has been appointed as a member-at-large to the Tissue Engineering and Regenerative Medicine International Society-EU chapter (TERMIS-EU) Continental Council and has also been made the European representative of the world council for a three-year term.

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Members in the News

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Subrata Saha, Ph.D., Research Professor and Director of Musculoskeletal Research, Department of Orthopaedic Surgery and Rehabilitation Medicine, SUNY Downstate Medical Center, Brooklyn, N.Y., received the Distinguished Alumnus Award from the Bengal Engineering and Science University in India, at its commencement ceremony January 19, 2013. The Award was given by Pranab Mukherjee, President of India. Dr. Saha was also the keynote speaker at the International Workshop on Recent Trends on Biomedical and Allied Engineering in Shibpur, India, in January 2013 and at the International Conference on Biologically Inspired Engineering at Nagpur, India, also in January, 2013.

J. Paul Santerre, Ph.D., Director of the Institute of Biomaterials and Biomedical Engineering at the University of Toronto, recently received a national award from the Natural Sciences and Engineering Research Council of Canada. Dr. Santerre, winner of an NSERC Synergy Award for Innovation, has worked with the University of Toronto's Institute of Biomaterials and Biomedical Engineering as well as the university's Faculty of Dentistry and Interface Biologics, Inc. led to a partnership to producing transformative biomedical polymers to make medical devices safer and more effective and to develop new technologies to program biocompatibility directly into the raw plastic resins, before device production, making device manufacturing more cost-effective. Their proprietary materials have led to the development of products ranging from high-volume devices, such as catheter lines, to highly specialized polymer coated stents for opening up blocked arteries.

Dr. Hélder A. Santos, from the University of Helsinki, Finland, recently received a European Research Council grant. His research group is focused on porous silicon particles that can be filled with anti-cancer drug molecules.

Jessica Winter, Ph.D., Associate Professor in Chemical and Biomolecular Engineering and Biomedical Engineering at the Ohio State University, was named 2012 Inventor of the Year by TechColumbus, a public-private partnership whose mission is to accelerate the advancement of Central Ohio's innovation economy. The accolade was one of TechColumbus' 2012 Innovation Awards, a program recognizing forward-thinking individuals, companies and technology teams in the 15-county region of Central Ohio for their achievements and contributions in technology leadership and innovation. Dr. Winter, founder and interim CEO of Core Quantum Technologies, an OSU technology commercialization company, received the award for her work on nanoparticle materials.

Michael J. Yaszemski, M.D., Ph.D., from the Mayo Clinic, Department of Orthopaedics and Bioengineering, recently received the American Academy of Orthopaedic Surgeons Tipton Leadership Award at their 2013 annual meeting. This is the AAOS's highest award.

The American Institute for Medical and Biological Engineering (AIMBE) has announced its Fellows for 2013 which includes the following SFB members: **Susmita Bose, Ph.D.,** Professor, School of Mechanical and Materials Engineering Affiliate Professor, Department of Chemistry Director, Bioengineering Research Center Washington State University; **Gary Bowlin, Ph.D.,** Professor, Virginia Commonwealth University; **David Castner, Ph.D.,** Associate Dean for Infrastructure, College of Engineering, University of Washington; **Esmaiel Jabbari, Ph.D.,** Professor of Chemical Engineering, University of South Carolina and **Thomas Webster, Ph.D.,** Chair and Professor of Chemical Engineering at Northeastern University in Boston.

The National Academy of Engineering elected 69 new members and 11 foreign associates in 2013. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "…engineering research, practice or education, including, where appropriate, significant contributions to the engineering literature," and to the "…pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering or developing/implementing innovative approaches to engineering education." New members (and their distinction, as indicated according to the Academy) from our Society include: **James M. Anderson, M.D., Ph.D.,** Distinguished University Professor and Professor of Pathology, Macromolecular Science and Biomedical Engineering, Case Western Reserve University, "For contributions to understanding tissue/biomaterials interactions for designing and testing medical devices"; **Kam W. Leong, Ph.D.,** James B. Duke Professor of Biomedical Engineering, Pratt School of Engineering, Duke University, "For contributions to engineered drug delivery and non-viral mediated gene delivery"; **Edward W. Merrill, Ph.D.** Professor Emeritus, Department of Chemical Engineering, Massachusetts Institute of Technology, "For contributions to biocompatible materials, biorheology and biomedical engineering education."

Kristi S. Anseth, Ph.D., investigator, Howard Hughes Medical Institute and Distinguished Professor, Department of Chemical and Biological Engineering, University of Colorado, has been elected to the **National Academy of Sciences** for her distinguished and continuing achievements in original research. A former student of **Nicholas Peppas, Ph.D.,** Dr. Anseth has now been elected to all three Academies.

In Memoriam

Unfortunately, we have recently lost two members of our Society, **David McQueen, M.D.,** who was employed with Kansas Orthopaedic Center P.A. in Wichita, Kan., and **J. Lawrence Katz, Ph.D.**, Emeritus Professor of Biomedical Engineering from Case Western Reserve University. Dr. Katz is a Past President of the Society.

Degradation of Implant Materials

Book Review

by Liisa Kuhn, PhD

ISBN 978-1-4614-3941-7 and ISBN 978-1-4614-3942-4 (eBook)
DOI 10.1007/978-1-4614-3942-4
Springer, New York Heidelberg Dordrecht London
516 pages *Edited By Noam Eliaz*

Noam Eliaz has brought together a team of experts from throughout the world to present the latest understanding of degradation of implant materials. When I first read the title and the word "implant," I wasn't sure what was going to be covered in the book and if it applied to my research interests. Would he cover dental implants? Orthopedic implants? Intraocular lenses? Stents? Polymers or metals?

Here's the table of contents:

1. Medical Implant Corrosion: Electrochemistry at Metallic Biomaterial Surfaces
2. Degradation of Titanium and Its Alloys
3. Degradation of Dental Implants
4. In Vivo Aging and Corrosion Aspects of Dental Implants
5. Biodegradable Metals
6. Degradable and Bioactive Synthetic Composite Scaffolds for Bone Tissue Engineering
7. Biodegradation of Calcium Phosphate Cement Composites
8. Enzyme-Promoted Degradation of Polymeric Matrices for Controlled Drug Delivery: Analytical Model and Numerical Simulations
9. Degradation of Bioceramics
10. Fundamentals of Tribology and the Use of Ferrography and Bio-Ferrography for Monitoring the Degradation of Natural and Artificial Joints
11. Fatigue Failure of Materials for Medical Devices
12. Hypersensitivity to Implant Debris
13. Implant Infections and Infection-Resistant Materials
14. Biomaterial Calcification: Mechanisms and Prevention
15. Orthopedic Implant Retrieval and Failure Analysis
16. The Use of Finite Element Analysis in Design, Life Prediction, and Failure Analysis of Biomaterials and Medical Devices
17. Biological Safety Evaluation of Polymers
18. Biological Responses to and Toxicity of Nanoscale Implant Materials

As you can see, the book covers a wide area of biomaterials science. Noam Eliaz, known for his work in corrosion, has gone beyond corrosion of metals to include chapters about degradation of polymers, calcium phosphates and the biological effects of the degradation by including chapters about safety evaluation, hypersensitivity and biological responses to nanoscale implant materials. The chapters are all well written, many by members of the Society For Biomaterials at the top of their field. I have a personal interest in ceramic, dental and orthopaedic implants and controlled release materials. Even with my more than 20 years of experience in these areas, I found there was something new to learn in every chapter. I recommend this book to you as members of SFB.

Here is a snapshot of the kind of content I found interesting:

- Did you know that after glutaraldehyde crosslinking, devitalized cells in the tissue do not possess active processes to push out calcium? Thus, devitalized cells have been shown to be the predominant sites of calcification in clinical bioprosthetic valves.
- There are magnesium-based biodegradable metallic implants.
- Nitric oxide release is a way to prevent bacterial growth.

Chapter 15 (by L.C. Jones, A.K. Tsao, and L.D.T. Topoleski) on Orthopedic Implant Retrieval and Failure Analysis is very good. I have sent it to some of my clinician colleagues to share with their residents and trainees because it summarizes the issues in the field so well. The authors bring up the topic of orthopedic implant retrieval programs. Accessing these tissues can be a valuable teaching tool, but currently there are no large national programs due to, in part, implant manufacturer concerns and liability. One of our SFB special interest groups– the Implant Pathology SIG-has brought up the idea of an implant repository. More detailed information about that will come in another issue of the *Forum*.

Eliaz nicely sums up the content and who might benefit from reading the book in his preface, part of which I'll share with you here:

"This book summarizes the current understanding of the mechanical, chemical and biological processes responsible for the degradation of a variety of implant materials. The 18 chapters were written by internationally renowned experts and address both fundamental and practical aspects. Different failure mechanisms such as corrosion, fatigue and wear are reviewed, together with experimental techniques for monitoring them, either in vitro or in vivo. Procedures for implant retrieval and analysis are presented. A variety of biomaterials (stainless steels, titanium and its alloys, magnesium alloys, polyethylene, polycarbonate-urethane, biodegradable polymers, calcium phosphates, etc.) and medical devices (orthopedic and dental implants, stents, heart valves, etc.) are analyzed in detail.

I hope this book will become a reference source for undergraduate and graduate students, college and university professors, scientists, engineers, implant manufacturers, venture capitalists, regulatory entities and research professionals working both in academia and industry. It may be of interest to materials, mechanical, biomedical and corrosion engineers; biologists and medical doctors; chemists and electrochemists; surface scientists; failure analysts; etc."

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