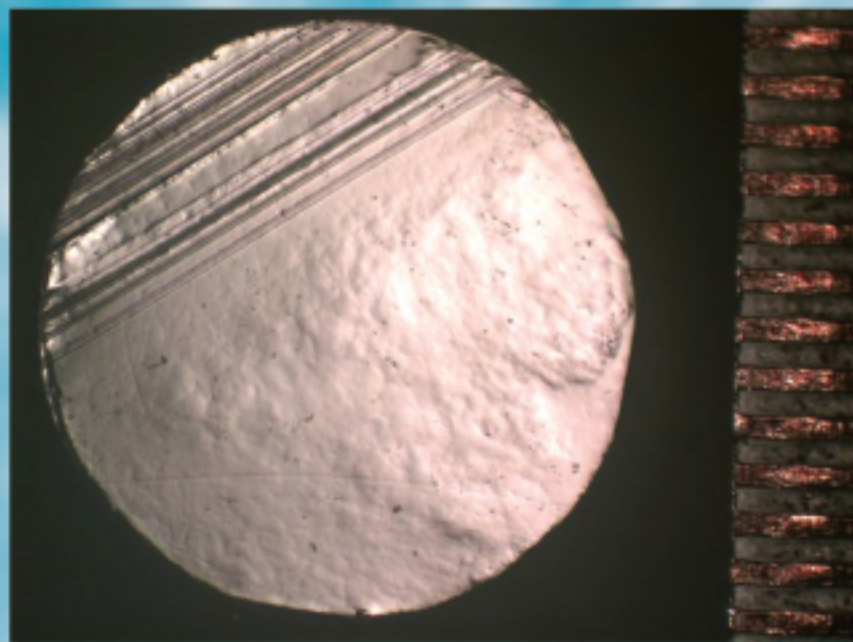


Long Range Planning Update

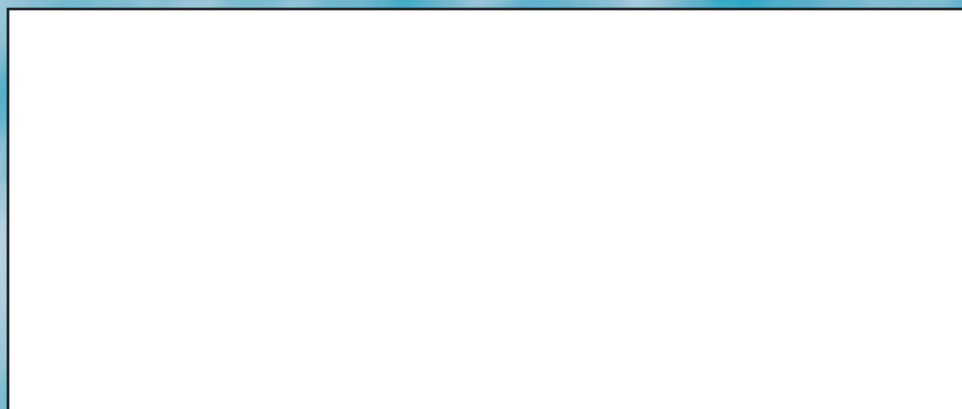
BIOMATERIALS FORUM



Fourth Quarter 2008 • Volume 30, Issue 4



B-Sheet Formation and RGD-Presentation Effects on Osteoblast Differentiation



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BIOMATERIALS FORUM



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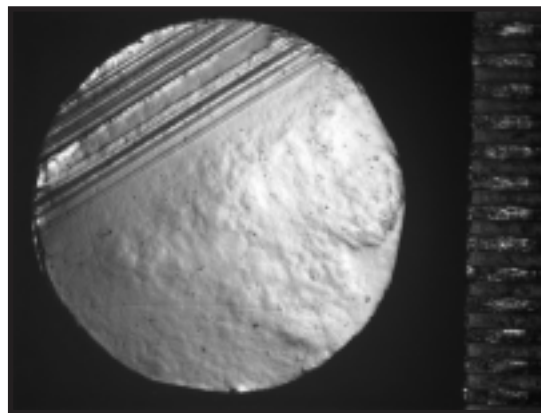
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Features

7 **β -Sheet Formation and RGD-Presentation Effects on Osteoblast Differentiation**

This article highlights the recent investigation into β -sheet formation and RGD epitope presentation (arginine-glycine-aspartate) on the surface of blended silk films. Surface characterization of biomaterials for tissue-engineering applications is of great importance in understanding how properties drive cellular response. Polymer crystallinity and surface modification with bioactive motifs, such as arginine-glycine-aspartate peptide (RGD), alter cell attachment. In protein-based materials, crystallinity is driven by the transition of α -helix to β -sheet, as is seen in silk.



Stereometric image of a pin-on-disk polyethylene wear surface at after 20Km of multi-directional sliding

Photograph courtesy of Dr. John Desjardins, Assistant Professor of Bioengineering, Clemson University

Departments

The Torch

- 2 From the Editor
- 2 From the President
- 3 Staff Update from Headquarters
- 5 Long Range Planning Update
- 5 Update from Member-at-Large
- 6 The Tale of Two Engineers

Member News

- 9 Members in the News

Government News

- 10 News on NIH Programs

Book Reviews

- 11 Tissue Engineering

Industry News

- 12 BioInk

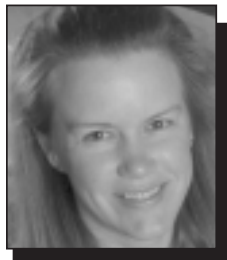
Biomaterials Community

- 12 Community Calendar

From the Editor

The Torch

By Karen J.L. Burg



As we wrestle with poor economic times, we are all examining our 2009 budgets and keeping on our calendars only those events that pass through the “necessary” filter. We also are under pressure from constituents who are concerned about the most efficient use of limited resources. In fact, we may sometimes forget there are a number of stakeholders who keep a watchful eye

on our activities. They include the public, tuition-paying students or parents, shareholders of a company, donors to a university, a board of directors, etc. With increased budget constraints, there is ever more scrutiny of perceived “unnecessary” activities. Travel is often perceived as an extravagance. So as you consider your own busy schedule and tight budget, and debate whether it is financially sensible for you to attend the SFB 2009 Annual Meeting, let me tell you why I think it is worth your while to attend.

I find great value in attending conferences. It is an opportunity to make new friends and to visit with “old” friends. It is an opportunity to meet vendors and publishers, all gathered in one location specifically to talk with attendees. It is an opportunity to meet with a potential funder or a collaborator.

Conferences are also an opportunity to refresh one’s thought processes. Too often we view the world with the blinders of our immediate surroundings. Attending conferences allows one to reconfirm relevance of one’s own work and provides one with an ego check by placing one’s work in the context of the field.

Early SFB meetings were people based—people who clearly enjoyed meeting one another and trading ideas. The 2009 Program Committee is diverse by design (including two San Antonio-based members, and industry, academic, and clinical representatives) to provide the best range of content. So should you opt out of this year’s meeting in light of poor financial times? No, I think not—we have done our very best to make the meeting worth your while, to provide you with an opportunity to consider new and familiar topics, catch up with friends and make new ones, develop new collaboratives and further existing initiatives, and make new business deals. Everything is indeed an opportunity.

Best wishes from Clemson,

Karen J.L. Burg
Hunter Endowed Chair & Professor of Bioengineering
Interim Vice Provost for Research & Innovation
Clemson University

From the President

The Torch

By Jeffrey A. Hubbell

Coming from one exciting event and off to the next.



Last September’s SFB Symposium on Translational Biomaterials Research, “Advancing Discoveries from the Laboratory to the Clinic,” was an exciting scientific event for the membership and other attendees from industry and academia alike. In its plenary sessions, the meeting highlighted successful translation examples, where impact in the clinic is

already being felt or is well on the way to being demonstrated, clearly illustrating the power of a biomaterials approach to therapeutics. What was perhaps most impressive about the meeting was the excellent scientific level of the talks and posters presented, proving the distance between fundamentally-innovative, clinically-driven ideas and clinical impact can be very short indeed. In the symposium, the Society carried out the critical function of being a conduit between academic innovation at the front-end and industrial innovation in development, clinical testing, and ultimate translation to the patient.

Coming closely on the heels of this focused Symposium is the Society’s Annual Meeting, to be held in April in San Antonio. Here, both basic and translational topics will be featured, ranging from topics such as nanobiomaterials, biofunctional

materials, and novel biomolecular functionality to applications such as stenting in the coronary artery, materials in tissue engineering, and materials in immunotherapy. Basic materials science, basic biology, and combination in biomaterials innovation present very intriguing challenges, and it will be exciting to see how members of the Society and other attendees tackle those challenges to illuminate biology and translate to clinical impact. The science, combined with the vibrant venue of San Antonio during the city’s Fiesta (www.fiesta-sa.org), will be very stimulating!

The leadership of the Society has been diligently active in carrying out some of the operational and strategic activities we have identified. Of particular interest to the membership is the recent launch of the new SFB Web site, www.biomaterials.org, which features new content in biomaterials news, educational materials, a job search, and information on the activities of the society. The Editors of the *Journal of Biomedical Materials Research A* and *B* are working hard with the Publications Committee and others in the Society leadership to restructure the journals and their editorial structure as well as the formatting of the journal articles to create space for more articles per issue. These changes will occur around the time of the Annual Meeting. Keep tuned for more detailed information!

The Society For Biomaterials is pleased to announce the launch of its new Web site! The new Web site features a search function that will return results from past years' meeting transactions, a biomaterials news feed, and a members only area with sections dedicated to each Special Interest Group and Committee. Visit www.biomaterials.org!

SFB hosted a symposium on Translational Biomaterials Research September 11-13, 2008 in Atlanta that drew 400 attendees and included a social event at the Georgia Aquarium! Evaluations of the symposium's program and the social event were both extremely positive. To review the meeting evaluation survey, please visit the members only area of the SFB Web site.

I am very pleased to announce a new addition to the headquarters team, Dennis Johnson, the new Assistant Executive Director! Dennis comes to us from the Rheumatology Nurses Society (RNS), where he served as the marketing and development manager, and previously the American Society of PeriAnesthesia Nurses (ASPAN) as the director of marketing and development. His previous responsibilities included developing marketing plans with major pharmaceutical and medical device companies, managing exhibits, sponsorship, and satellite symposia. Prior to entering the world of nonprofit association management, Dennis handled medical device and equipment sales and worked with some of the country's largest manufacturers, including Merck and Co., Abbott Laboratories, and Novartis Pharmaceuticals.

The Program Committee continues to prepare for the 2009 Annual Meeting, which will be held April 22-25, 2009, at the Grand Hyatt San Antonio in San Antonio, Texas. The meeting will take place during San Antonio's annual Fiesta, which should make for great fun after the daily program has concluded! A listing of events in and around San Antonio during fiesta is available on the SFB Web site.

Several new initiatives are also underway, including the development of a new book series and the formation of two new Special Interest Groups, one in nanomaterials and possibly a second in spine.

Committee Reporting

Each of the Society's committees is listed below, with the committee members who have been either elected or appointed, and the goals that each committee would like to accomplish during their one-year term.

Awards, Ceremonies & Nominations Committee

Members include Michael Sefton, University of Toronto (Chair); Kristi Anseth, University of Colorado; Joel Bumgardner, University of Memphis; Andres Garcia, Georgia Institute of Technology; David Mooney, Harvard University; Narendra Vyavahare, Clemson University (Ex-Officio). The goals of the 2008-2009 committee are to solicit and evaluate nominees for the Society's awards and officers, present Council

with recommended candidates for 2009 Awards, and present a slate of officers to the membership for election in 2009. In addition, this year's committee will be supervising the revision of the Awards and Officers nominations Web sites.

Bylaws Committee

Members include Joel Bumgardner, University of Memphis (Chair); Barbara Blum, Wright Medical; Christopher Damien, Dentsply International; Shah Jahan, University of Memphis; Jack Ricci, New York University. The goals of the 2008-2009 committee are to consider and report on questions and problems arising with respect to the bylaws of the corporation, and make recommendations for revisions to the Council.

Devices & Materials Committee

Members include Jeremy Gilbert, Syracuse University (Chair); Julie Hasenwinkel, Syracuse University; Mike Helmus, Advance Nanotech; Ebru Oral, Massachusetts General Hospital; Nadim Hallab, Rush University Medical Center. The goals of the 2008-2009 committee are to collaborate with ASM on a new research materials database module and identify other areas of collaboration; establish stronger links with partner societies in the area of regulatory matters (ASTM F-4 committee); develop a strategic plan to connect more strongly with medical device companies undertaking biomaterials research.

Education & Professional Development Committee

Members include Julie Trudel, Medtronic (Chair); Angela Au, Nutramax Laboratories; Ken Messier, Genzyme; Gene Park, Medtronic; Shane Woods, Synthes; Margaret Phillips, University of Texas (National Student Chapter President). The goals of the 2008-2009 committee are to develop programmatic content for a new webinar series; assist the student chapter with program development for the 2009 Annual Meeting; reestablish as many student chapters as possible; re-examine the Student Chapter Bylaws; explore other opportunities for student programming. In addition, the committee will continue to evaluate endorsement requests from other organizations and will explore other opportunities for program activity.

Finance Committee

Members include Antonios Mikos, Rice University (Chair); Aaron Goldstein, Virginia Polytechnic Institute; Lynne Jones, Johns Hopkins University; Johnna Temenoff, Georgia Institute of Technology and Emory University; Alan Litsky, Ohio State University (Ex-Officio). The goals of the 2008-2009 Finance Committee include the implementation and oversight of the Board-approved investment and reserve policies.

Liaison Committee

Members include Molly Shoichet, University of Toronto (Chair); Kevin Healy, University of California-Berkeley; Kristi Anseth, University of Colorado; Bill Wagner, University of Pittsburgh. Goals of the 2008-2009 committee include interacting with the 2012 WBC Organizing Committee on programmatic and organizational matters and identifying

continued on page 4

continued from page 3

opportunities for collaboration with the ORS, MRS, BMES, and other organizations.

Long Range Planning Committee

Members include Lynne Jones, Johns Hopkins University (Chair); Julia Babensee, Georgia Institute of Technology; Hamed Benguzzi, University of Mississippi Medical Center; Andrea Gobin, University of Louisville; Kandice Kottke-Marchant, Cleveland Clinic; Robert Miller, Genzyme. The committee is continuing to work on the strategic plans for Membership and for the Annual Meeting. The committee is in the process of gathering input relating to the Strengths, Weaknesses, Opportunities, and Threats (SWOT analysis) of these two areas of focus. The committee intends to conduct surveys of membership regarding these issues in the near future.

Meetings Committee

Members include Jeffrey Hubbell, Ecole Polytechnique Federale de Lausanne (Chair); Karen Burg, Clemson University; Alan Litsky, Ohio State University; Tony Mikos, Rice University; Julia Babensee, Georgia Institute of Technology. The goals of the 2008-2009 Committee are to analyze 2007 Annual Meeting survey data; evaluate venues for future meetings and social events; assess the funding and sponsorship revenue of our Annual Meetings, and to provide recommendations for increasing these sources of revenue to better offset meeting attendee registration costs.

Membership Committee

Members include Nicholas Ziats, Case Western Research University (Chair); Luis Avila, Genzyme; Alireza Khademhosseini, Harvard-MIT; Helen Lu, Columbia University; Laura Suggs, University of Texas at Austin. The committee has laid out goals for the upcoming year with its continuing plan of recruiting new members into the Society as well as a retention plan for current, active members. The committee is planning on working with the Education Committee to set up more student chapters for the upcoming year, with a goal to start 10 new chapters, focusing in Texas as we draw nearer to the San Antonio meeting in 2009. The committee meeting in August focused on the budgetary plan for 2009 and this was submitted to Council. Finally, in September, Chair Ziats attended the SFB Board/Council Meeting held in Atlanta, and an updated report on the committee activities was submitted.

Presidents Advisory Committee

The committee comprises all past presidents of the Society and is chaired by the Immediate Past President, Martine LaBerge. The goals of the 2008-2009 President's Advisory Committee are to: 1) provide support to the President and Council in the review of the Society's publications to determine how well the SFB and the intellectual field are currently served and suggest changes if any; 2) complete an archival monograph describing the history of the Society, and 3) address mechanisms to assure the financial support of scholarships and education activities of the Society.

Program Committee

Members include Karen Burg, Clemson University (Chair); Lynne Jones, Johns Hopkins University; Julia Babensee, Georgia Institute of Technology; Joel Bumgardner, University of Memphis; Kristine Kieswetter, Kinetic Concepts; Gabriele Niederauer, ENTrigue Surgical; Phil Messersmith, Northwestern University; William Reichert, Duke University; and Waleed Shalaby, Lehigh Valley Hospital. The goals of the 2009 committee are to develop and promote the scientific program for the 2009 Annual Meeting and foster engagement and collaboration with, and between, the Society's Special Interest Groups.

Publications Committee

Members include Ashutosh Chilkoti, Duke University (Chair); Syed Hossainy, Abbott Vascular; David Grainger, University of Utah; Peter Jarrett, I-Therapeutix; the editors of the Society's publications—James Anderson, Case Western Reserve University (JBMR-A); Harold Alexander, Orthogen (JBMR-B); Karen Burg, Clemson University (Biomaterials Forum); Thomas Webster, Brown University (Web site). The goals of the 2008-2009 committee include selecting a new editor for the *Journal of Biomedical Materials Research—Part B Applied Biomaterials*; revamping the editorial processes of the journal; identifying an editor for the forthcoming book series; and continuing to review all Society publications.

If you are interested in knowing more about a particular issue, policy or committee activity, or if you have any suggestions for improved membership services, please contact me directly at the SFB headquarters office.

Sincerely,



Dan Lemyre, CAE
Executive Director

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Long Range Planning Committee Update

The Torch

By Lynne Jones,
Long Range Planning Committee Chair

After the SFB Strategic Planning Retreat held in fall 2005, the Long Range Planning Committee (LRPC) was reinvigorated to respond to its original charge: to advise and consider recommendations to the Council regarding the long-range direction and future of the Society. Five Task Force groups were formed to address governance, programs, Special Interest Groups, revenue, and branding. Recommendations were made and specific tasks were implemented. The impact of these task forces continues today. The Long Range Planning Committee (LRPC) for 2008-2009 carries on in this spirit.

Committee members are from different constituent groups of our membership (e.g., academia, industry, students, young investigators, experienced researchers). The members of the LRPC are:

- Lynne C. Jones, PhD, Chair, Johns Hopkins University
- Julia Babensee, PhD, Member-at-Large, Georgia Institute of Technology
- Margaret Phillips, President of the National Student Chapter, University of Texas at Austin
- Hamed Benghuzzi, PhD, University of Mississippi
- Andrea Gobin, PhD, University of Louisville

- Kandice Kottke-Marchant, MD, PhD, Cleveland Clinic
- Robert (Bob) Miller, PhD, Genzyme Corp.

The LRPC has been charged to focus on two major issues of vital importance to our Society: the Annual Meeting and membership. These issues have wide-ranging implications for the long-term health of our Society. With respect to the Annual Meeting, we will begin by reviewing the prior Task Force report, LRPC recommendations, and final reports of previous Annual Meetings. Regarding membership, reports to Council from past years will be reviewed. A SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis will be conducted for both the Annual Meeting and membership. This analysis will be based upon input from the LRPC members, members of the Program and Membership Committees, as well as from surveys and open discussions with a broad sampling of our membership.

The goals of the LRPC are to update the strategic plan for the Annual Meeting that was proposed by the past Long Range Planning Committee and to develop a new strategic plan for membership. Benchmarks and a timeline will be established to meet each of the proposed goals.

Update from Your SFB Member-at-Large

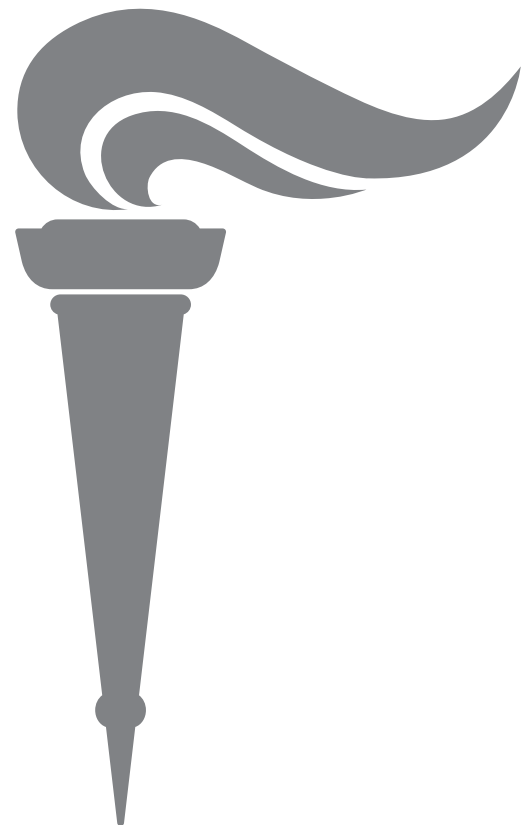
The Torch

By Julia Babensee, Society Business and
Membership News Contributing Editor

The Society For Biomaterials is a dynamic and vibrant society “giving life to a world of materials.” This is our Society. Our interests lie in best serving all of our member constituent groups—academia, industry, clinicians, government, and students. One of the biggest benefits to members is the Annual Meeting. We want to make this meeting fun and the best meeting to learn about what is going on in the field of biomaterials and its application areas. What are our member constituent groups interested in getting out of the Annual Meeting? One group we are particularly interested in hearing from is industry. For example, for the biomaterials currently being used, what are new developments of interest to industry? How can we facilitate interactions between industry and academia?

I encourage you to get involved in the Society For Biomaterials. We have great volunteers committed to the Society and making it work. You can get involved by joining a Special Interest Group, submitting a proposal for a session/workshop/symposium for the Annual Meeting, nominating a colleague or student for an award or officer position, or accepting a nomination yourself. These are some of the ways you can help shape the Society. Moreover, you can come to the meeting, present a paper, listen to others and enjoy the bash—you missed a great evening at the Georgia Aquarium if you were not present for the last meeting.

As always, I welcome your feedback on the Society For Biomaterials and how we can enhance the value of your membership. Please send me an e-mail at julia.babensee@bme.gatech.edu.



The Tale of Two Engineers

The Torch

By Guigen Zhang, University & Research
Institution News Contributing Editor

“If one follows the business media, one may come across such contentious headlines like ‘The Death of U.S. Engineering.’

What is going on?”

Does the United States need more engineers? This question puzzles many, from university professors and administrators to business executives and policy makers, as they wrestle with maintaining our competitive edges in an increasingly flat world. For example, every time Bill Gates urges Congress to act upon the need for more knowledge workers in science and engineering, the following days are filled with echoes of arguments to the contrary. The latest movements in the National Academy of Engineering (NAE) give the sense of urgency for improving the quality of engineering education but not for increasing the number of engineers. However, if one follows the business media, one may come across such contentious headlines like “The Death of U.S. Engineering.”

What is going on?

To satisfy my curiosity, I dug a little deeper. Here is what I found: there are two kinds of engineers.

To some, engineers are merely skilled workers, trained to design and manufacture products or machines. As Paul Roberts stated in his piece “The Death of U.S. Engineering,” with the spread of globalization where corporations move their manufacturing offshore, “a country that doesn’t make things doesn’t need engineers and designers.” These engineers are the “traditional kind of geeks” who are competent and comfortable in their narrow technical world but are lacking in a deeper appreciation of the larger world. Whenever there is a change in the larger world, this kind of engineer will likely ask: “Who moved my cheese?” Or, “why does the work I have been doing all my life now only pay \$7 per hour?”

And then there is another kind of engineer—those who transform new knowledge into products, processes, and services. According to the road map laid out by the NAE in “Engineering Research and America’s Future: Meeting the Challenges of a Global Economy,” engineers of this kind are transforming scientific discoveries into new technologies to increase life expectancy, drive economic growth, improve the standard of living, develop new energy sources, and provide sufficient water supplies. They are a “new kind of geeks” who are not only technically competent but also have a deep consciousness of the humanistic context of the larger world. When a change occurs in the larger world where they may have been major contributors, these engineers will likely ask, “What should the new cheese be like?” instead of, “Who moved my cheese?”

So this is the tale of the two kinds of engineers.

Now, having heard this tale, do you know the answer to the question I asked at the beginning? Unfortunately, it seems still unclear to many. I often hear people citing Federal Reserve Chairman Ben Bernanke: “simply producing more scientists and engineers may not be the answer because the labor market for those workers will simply reflect lower wages and perhaps greater unemployment for those workers. Currently, there’s not an obvious shortage of scientists and engineers in terms of the labor market indicators; that is, wages for engineers are not rising more rapidly than other professionals.”

But you would be wrong if you simply think Bernanke is against producing more scientists and engineers. The Federal Reserve Chairman has also advised we should focus on creating a demand side to strengthen the market. Bringing people into science and engineering in the “traditional ways” because there are job opportunities today will simply create a bigger supply and soon compete with others globally for the same kind, and drive down the wages in that category.

The demand side!

It appears if the new engineers we are going to produce are not just for job consumption but for opportunity creation, we would have this demand side covered. How will we do it, then? The answer lies in innovation, because engineering is the engine of innovation. Speaking of innovation, I want to reemphasize it is different from invention, as I stated in my “Invention vs. Innovation” piece (*Biomaterials Forum*, 30, 2, 2008). Whereas invention is the act of creating something new, innovation is the act of converting something new (a new form of thing or knowledge) or something old (an existing natural material or knowledge) into a new wealth-producing resource, a resource with economic and social values. So, innovation emphasizes the inclusion of the social and economic value to the act of creating something new.

We may have too many “traditional technical geeks” who are struggling to seek fewer and disappearing jobs, but we will never have enough of the “new kind of geek” who will bring us new opportunities and new wealth.



β -Sheet Formation and RGD-Presentation Effects on Osteoblast Differentiation

Feature
Joy Dunkers,
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This article highlights our recent investigation into β -sheet formation and RGD epitope presentation (arginine-glycine-aspartate) on the surface of blended silk films.¹ Surface characterization of biomaterials for tissue engineering applications is of great importance in understanding how properties drive cellular response. Polymer crystallinity and surface modification with bioactive motifs, such as arginine-glycine-aspartate peptide (RGD), alter cell attachment.^{2,3} In protein-based materials, crystallinity is driven by the transition of α -helix to β -sheet, as is seen in silk.⁴

β -sheet formation was modulated through blending of regenerated *Bombyx mori* silk (fibroin) with engineered dragline spider silk (spidroin). The engineered silk was expressed through *E. coli* and contains two RGD sequences that the natural silk lacks.⁵ We fabricated discrete silk blends (90:10, 70:30, 50:50, 30:70 fibroin:spidroin) from solution by spin-coating onto glass coverslips. Briefly, a self-assembled monolayer of *n*-octyldimethylchlorosilane was vapor deposited on glass coverslips overnight. Forty microliters of silk solution (3 percent by mass in hexafluoroisopropanol) was deposited onto the coverslip while spinning at 2,000 rpm for 90 seconds. Pure fibroin and pure spidroin films were also fabricated as controls. The films were characterized with Fourier transform infrared spectroscopy (FTIR), film stability studies (delamination), atomic force microscopy, and peptide staining. Cellular attachment to the silk films was also investigated and the effects of β -sheet formation on cell spreading and differentiation were assessed.

FTIR revealed increased β -sheet formation with increased RGD-spidroin content after annealing (Figure 1).¹ Annealing increased the β -sheet content over the unannealed in all cases except the pure fibroin. When the films were incubated for 21 days in aqueous cell culture conditions, the increased β -sheet content improved film stability. The unannealed samples with less than 30 percent RGD-spidroin dissolved after seven days while the higher-content RGD-spidroin remained for 14 days. Annealing increased film stability through 21 days with only the pure fibroin dissolving after 14 days.

RGD presentation on the surfaces of the films was visualized with a novel approach using an integrin mimicking peptide (CWDDGWLC-biotin).⁶ Briefly, films were blocked with a solution of bovine serum albumin, incubated with CWDDGWLC-biotin (0.1 mg/mL), incubated with streptavidin-colloidal gold (10 nm, 3 ng/mL) and enhanced with silver staining. This technique enables detection of RGD on the surface of a biomaterial using light microscopy.

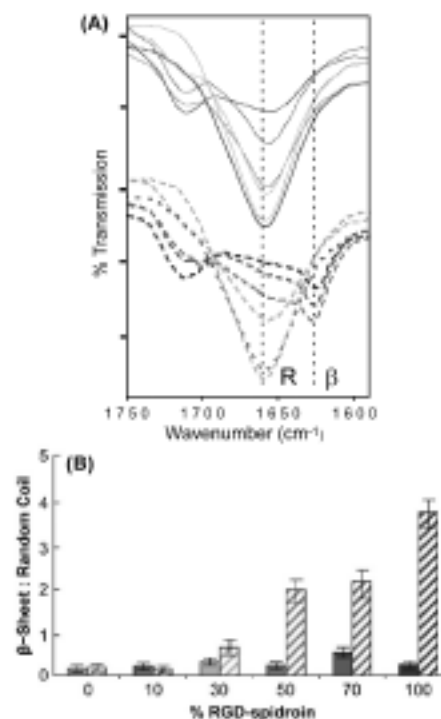


Figure 1. FTIR spectra of fibroin films containing 100% (purple), 70% (blue), 50% (turquoise), 30% (olive green), 10% (red), or 0% (orange) RGD-spidroin before (solid) and after (dashed) annealing. (A) Random coil regions (R: 1660 cm^{-1}) apparent in the unannealed samples were diminished with annealing and increasing RGD-spidroin content. Increasing β -sheet formation (β : 1640 cm^{-1}) was observed after annealing with increasing RGD-spidroin content. (B) The ratio between the β -sheet peak (β) and the random coil peak (R) reveals increasing β -sheet content after annealing in films with high RGD-spidroin content.

Appearing as dark spots against the grey background of the silk (Figure 2), the RGD epitope was visible on the pure spidroin prior to annealing. For most compositions, the unannealed blends showed increasing staining with increased RGD-spidroin content. The pure fibroin lacks the RGD epitope and therefore displayed no staining before or after annealing. After annealing, most of the blends and the pure spidroin showed decreased RGD presentation on the film surfaces.

Cell adhesion, spreading, and differentiation were assessed on the films using a model osteoblast cell line, MC3T3-E1. Cell adhesion at four hours was statistically similar for all compositions and annealing conditions. By four days, cells proliferated as expected with approximately two doublings for all specimens, with no significant difference in cell number for all compositions and annealing conditions. After four hours,

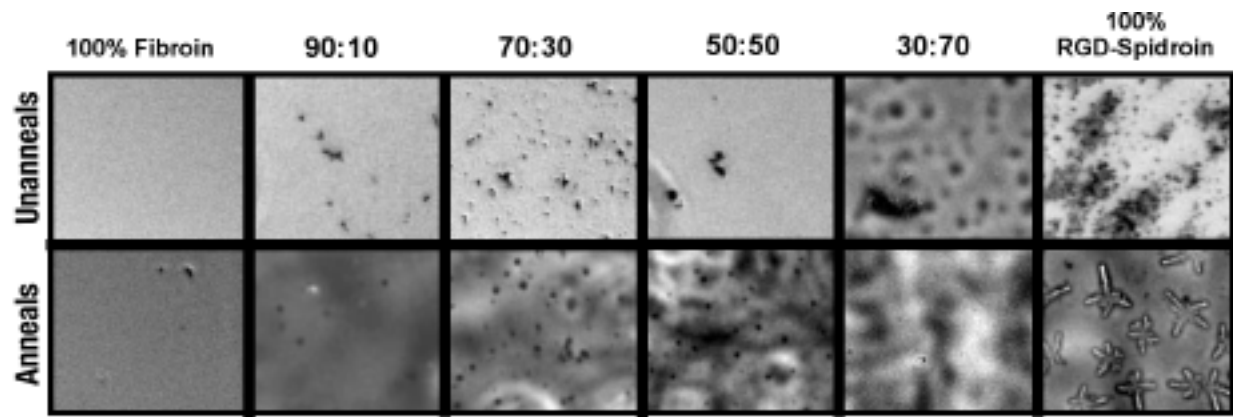


Figure 2. Representative light micrographs of RGD-epitope presentation visualized with phage peptide-biotin/streptavidin-gold nanoparticle enhanced with silver. Dark clusters of the RGD-epitope are present with increasing amounts of RGD-spidroin. The amount of epitope on the surface decreased after annealing. Little to no staining was observed on the pure fibroin where the RGD sequence is not present. 400x magnification.

unannealed blended samples showed an unexpected decrease in cell spreading with increased RGD-spidroin content. Cells on the annealed samples displayed no obvious trend in cell area as a function of the RGD-spidroin content at four hours. By four days, all cells decreased in cell area irrespective of the amount of RGD-spidroin and heat processing. Surface roughness determined by atomic force microscopy increased after annealing suggesting chain rearrangement was involved in the formation of β -sheet, which “hid” the RGD after annealing.

Due to film stability, only annealed samples were investigated for cellular differentiation. Cells reached confluence on most specimens, including glass controls by seven days (Figure 3). Osteoblastic differentiation was monitored by osteopontin expression after 14 days. Although silk samples produced more osteopontin than the glass controls, no difference in osteopontin expression was detected between silk films.

In this study,¹ the addition of synthetic RGD-spidroin led to increased β -sheet formation in the silk-blend films. Higher β -sheet content led to greater film stability under culture conditions, allowing for pre-osteoblasts to differentiate into mature osteoblasts, although no differentiation differences were noted among the blends. Therefore, it was concluded the 90:10 fibroin:RGD-spidroin blend (by mass) was the optimal composition for supporting osteoblastic cells in this study. This blend offered film stability for cell attachment at the lowest RGD-spidroin content, making it less expensive to fabricate. Finally, a novel technique was developed to examine RGD presentation on silk film surfaces and the results were in good agreement with the cellular response studies.

Acknowledgement

The silk materials were produced at Tufts University (Tissue Engineering Research Center, TERC, NIH P41 EBO02520) (DLK). The authors gratefully acknowledge support from an NIST Innovation in Measurement Science Award (MLB), a National Academies of Science Postdoctoral Fellowship (AWM), and a NSF-NIST Summer Undergraduate Research Fellowship (KER). Results are reported as the mean \pm standard error of the mean, and standard error of the mean is the same as the “combined standard uncertainty of the mean” for the purposes of this work. This article, a contribution of the National Institute of Standards and Technology, is not subject to U.S. copyright.

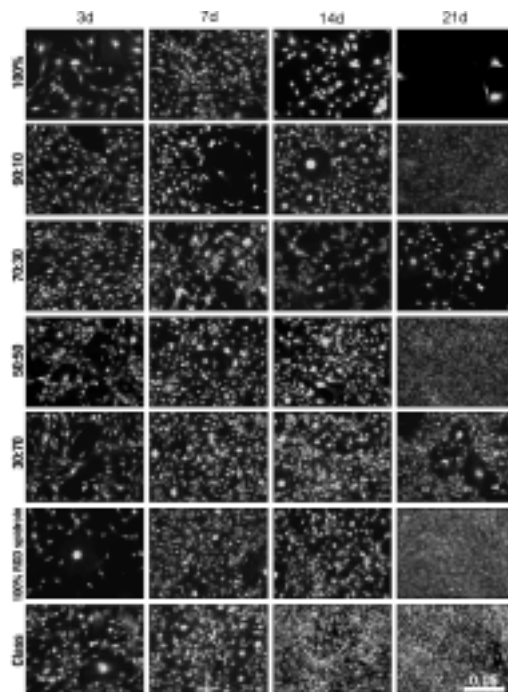


Figure 3. Fluorescent light micrographs of MC3T3-E1 cultured for 3 d, 7 d, 14 d or 21 d in differentiation media on annealed silk blends. Clean glass coverslips were used for the control. For most of the blends, cell number appears to increase with time as RGD-spidroin content is increased.

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6. Pasqualini R, Koivunen E, Ruoslahti E. A peptide isolated from phage display libraries is a structural and functional mimic of an RGD-binding site on integrins. *J Cell Biol* 1995; 130:1189-96.

Congratulations to:

Kristi Anseth (University of Colorado), **Cato Laurencin** (University of Connecticut), **Edward Merrill** (Massachusetts Institute of Technology), **Nicholas Peppas** (University of Texas at Austin), and **Buddy Ratner** (University of Washington) who were cited by the American Institute of Chemical Engineering (AIChE) Centennial Celebration committee as Chemical Engineers of the Modern Era. The Committee recognized 100 chemical engineers who have attained AIChE senior member status and are guiding the profession into the new century.

Lisa Brannon-Peppas, VP and Chief Scientific Officer of Appian-Advanced Therapeutic Design, who received the 2008 AIChE Award in Chemical Engineering Practice. The award recognizes outstanding chemical engineering contributions in the industrial practice of the profession and is presented to an AIChE member whose contributions may be in areas including, but not limited to, development, design, manufacturing, marketing, economic analysis, and planning, or the creation of a new business.

Mark Byrne, Assistant Professor of Chemical Engineering at Auburn University, who received the Auburn Alumni Association's Alumni Undergraduate Teaching Excellence Award. The award is presented on the basis of outstanding teaching of undergraduates from nominations made by alumni and students with letters of support from department heads and deans. Byrne teaches both undergraduate and graduate courses within the Department of Chemical Engineering and conducts research in the areas of biomaterials, medical devices, and drug delivery. He also co-directs the Auburn National Science Foundation Research Experiences for Undergraduates program in micro/nano-structured materials, therapeutics, and devices.

Jeff Hubbell, of the Ecole Polytechnique Fédérale de Lausanne, who received the AIChE Alpha Chi Sigma Award and the Food, Pharmaceuticals, and Bioengineering Award.

Cato Laurencin, who joined the University of Connecticut in August as VP for health affairs at the Health Center and as the seventh dean of the School of Medicine. Dr. Laurencin is also the Van Dusen Distinguished Endowed Chair in academic medicine. Dr. Laurencin is a Fellow of the American College of Surgeons and the American College of Orthopaedic Surgeons, is widely published in scholarly journals, and is the inventor of record on more than 20 U.S. patents. Dr. Laurencin was recently honored by *Scientific American Magazine* as one of the top 50 innovators for his groundbreaking technological work in the regeneration of knee tissue.

Nicholas Peppas, of the University of Texas at Austin, who is a recipient of the AIChE 2008 Founders Award for Outstanding Contributions to the Field of Chemical Engineering. This is the highest honor bestowed by AIChE to its members. Congratulations to Dr. Peppas, who has also been

New Biomaterials Science and Engineering Fellows

The honorary status of "Fellow, Biomaterials Science and Engineering" (FBSE) was established in April 1992 after the constituent biomaterials societies of the World Biomaterials Congress recognized the need for the public recognition of members who have gained a status of excellent professional standing and high achievements in the field of biomaterials science and engineering. Fellows are accomplished members and role models in the field of biomaterials science and engineering. Fellows are expected, through word and deed, to foster the field of biomaterials and to support its professional development as a practical and intellectual endeavor.

Congratulations to the following SFB members who are newly elected members of the International College of Fellows of Biomaterials Science and Engineering:

Mauli Agrawal University of Texas at San Antonio	Andrew Lloyd University of Brighton
Lisa Brannon-Peppas University of Texas at Austin	Anne Meyer University of Buffalo
Joost de Bruijn Queen Mary University of London	Molly Shoichet University of Toronto
Arthur (Art) Coury Genzyme Corp.	Paulette Spencer University of Kansas
Eugene Goldberg University of Florida	Hsing-Wen Sung Tsing Hua University
David Grainger University of Utah	Maria Cristina Tanzi Polytechnic of Milano
Lynne Jones Johns Hopkins University	Pentti Tengvall Linköping University
Martine LaBerge Clemson University	William Wagner University of Pittsburgh
Jui-Che Lin National Cheng Kung University	Heimo Ylanen University of Turku

elected to the board of the Biomedical Engineering Society for the period 2008-2011.

William "Monty" Reichert, Professor of Biomedical Engineering and Chemistry at Duke University, who is a member of the 2008-2009 class of American Council on Education Fellows. The ACE Fellows program, established in 1965, is the longest running leadership development program in the U.S. This prestigious program is designed to strengthen institutions and leadership in American higher education by identifying and preparing promising senior faculty and administrators for responsible positions in college and university administration. A total of 36 Fellows, nominated by

Continued on page 10

New NIH Roadmap Transformative R01 Program

The NIH has announced a new funding initiative called the “Transformative R01 Program” that was established to support exceptionally innovative, high risk, original and/or unconventional research with the potential to create new or challenge existing scientific paradigms. Projects in any area of NIH interest are encouraged and six areas of particular interest and need are highlighted. One of these areas of interest to the biomaterials community is “Complex 3-Dimensional Tissue Models.” In FY09 the NIH will commit \$25 million dollars to fund up to 60 applications submitted in response to this initiative. More information about the initiative can be found in the NIH Guide to Grants and Contracts at <http://grants.nih.gov/grants/guide/rfa-files/RFA-RM-08-029.html>.

Also, the NIH hosted a “Round Table Discussion” to help establish a dialogue and begin to address some of the questions associated with the new Roadmap initiative in the specific area of “Complex 3-Dimensional Tissue Models.” The broad objective was to illuminate potential transformative research for the field—to distinguish between incremental progress and work that will truly disrupt current paradigms.

Continued from page 9

presidents or chancellors of their institutions, were selected this year in a national competition.

Thomas J. Webster, Associate Professor, Division of Engineering and Department of Orthopedics, Brown University, who has just published a new book, *Safety of Nanoparticles: From Manufacturing to Medical Applications*, with Springer. The aim of the book is to provide one of the first detailed overviews of how cells and tissues in the body deal with nanoparticles. Accordingly, the book is a compilation of research at the intersection of nanoparticles and biological processes geared to determining if nanophase materials are safe to be manufactured, handled, and/or implanted for various medical applications.

Other Member News

The Department of Defense has announced Rice University and the University of Texas Health Science Center at Houston will be part of a national program to develop new regenerative tissue techniques to aid soldiers wounded in Iraq and Afghanistan. The institutions will receive \$20 million over the next five years to spearhead the development of new tissue-engineering technologies, novel reconstructive surgical techniques, and innovative drug therapies to help wounded soldiers. The new initiative, known as the Armed Forces Institute for Regenerative Medicine, is made up of two civilian

NIH Workshop: Transforming Regenerative Medicine: an Interdisciplinary Approach

A Workshop on “Transforming Regenerative Medicine: An Interdisciplinary Approach” was held May 19-20, 2008, in Bethesda, Md., by the National Institutes of Health. The primary objective of this workshop was to bring together leaders in the multiple fields constituting regenerative medicine to explore strategies for better coordinating biological knowledge, engineering technologies, and clinical needs, with resources to promote transformation of regenerative medicine. Through a series of four scientific sessions, a plenary talk, and a concluding session, this two-day workshop addressed the overarching questions: how do you build an effective regenerative medicine interdisciplinary team? How do you coordinate biological knowledge, engineering technologies, and clinical needs? What information and expertise is needed to effectively translate regenerative medicine research to patients/products? What can the NIH do to better coordinate regenerative medicine research to achieve transformation of this field?

The four scientific sessions included “Generation and Regeneration: Learning from Nature;” “Cell-Instructive Technologies for In Vivo Regeneration;” “3-D Engineered Tissues In Vitro and In Vivo; Functional Integration of Engineered Tissues: More Than the Sum of its Pieces.” A full summary of the workshop will be published soon on the NIH Web site.

research consortiums working with the U.S. Army Institute for Surgical Research at Fort Sam Houston in San Antonio. Rice bioengineer and SFB member **Antonios Mikos** and UT-Houston surgeon Mark Wong are overseeing the research on craniofacial reconstruction for a civilian consortium led by the Wake Forest Institute for Regenerative Medicine and the McGowan Institute for Regenerative Medicine at the University of Pittsburgh.

University of Pittsburgh researchers will help lead dozens of engineers and doctors from universities and industries around the world through a five-year, \$18.5 million project announced to develop implantable devices made from biodegradable metals. The devices will be designed to adapt to physical changes in a patient’s body and dissolve once they have healed, reducing the follow-up surgeries and potential complications of major orthopedic, craniofacial, and cardiovascular procedures and sparing millions of patients worldwide added pain and medical expenses. The project stems from a five-year National Science Foundation Engineering Research Center (ERC) grant to North Carolina A&T University and subcontracting partners University of Pittsburgh and University of Cincinnati. **William Wagner**, SFB member and Deputy Director of Pittsburgh’s McGowan Institute for Regenerative Medicine, will serve as the ERC Deputy Director.

Tissue Engineering

Book Review

By Liisa Kuhn

Senior editor: Clemens van Blitterswijk, and editors: Peter Thomsen, Anders Lindahl, Jeffrey Hubbell, David Williams, Ranieri Cancedda, Joost de Bruijn, Jerome Sohler. Copyright 2008, Academic Press/Elsevier, Burlington, MA, 664 pages, new \$110, used from \$89. A volume in the Academic Press Series in Biomedical Engineering, series editor J. Bronzino

Description

“This book provides a very useful guide for those who wish to understand important issues such as cell biology, materials science, and bioreactor design with respect to tissue engineering, as well as providing specific examples of how tissue engineering is accomplished.”—*From the foreword by R. Langer.*

“Tissue engineering is truly a multidisciplinary field where acquired knowledge from individual classical disciplines (e.g. polymer science, molecular biology) no longer suffices to make substantial leaps. Individuals active in this field will have to acquire multidisciplinary skills and be willing to look over the borders of their home discipline. The relatively young age of the field does not make it easy to acquire those skills as dedicated textbooks are still scarce and frequently do not address the appropriate audience by either offering a collection of research papers or by only dealing with a selected part of the entire discipline. Without the widespread availability of such textbooks it is to be feared that the rapidly increasing number of graduate courses on tissue engineering may not be as effective as required, which may hamper the development of the field of tissue engineering into a mature scientific discipline.”—*From the introduction by C. Blitterswijk, regarding the motivation behind this book.*

The result of the combined efforts of the editors and contributors is the textbook you have been seeking to teach tissue engineering to undergraduate and graduate biomedical engineering students. This textbook is also excellent for older biomaterials scientists interested in contributing to, or developing, a tissue-engineering program, but who do not have the courage to tackle molecular biology or cell biology textbooks. Complex biological topics, such as cellular signaling and embryogenesis, are covered at multiple levels, using a special format where use is made of separate text boxes to supplement typical chapter content. These text boxes address dedicated topics a student or teacher may select at will to provide deeper insight. They describe either a “Classic Experiment” or a “State of the Art” experiment. The descriptions of actual experiments reinforce the basic concepts discussed in the chapter and further expand on them to make connections with other sections in the book. They are similar to mini-journal articles, yet are flanked within the chapter by educational descriptions of the components manipulated in the experiment, allowing a novice comfortable entry to this research world.

The result is an in-depth textbook to neither turn away a beginner nor bore an experienced scientist. Crisp, colored figures and images of cells, scaffolds, and tissues are found throughout the book and provide eye candy to draw in the potential reader. Multiple-choice questions are included at the end of the book for ready-made in-class quizzes. Translational and clinical application of tissue engineering principles are demonstrated in five chapters devoted to skin, cartilage, bone,

nervous system, and organ system tissue engineering. A chapter on ethical issues related to creation of human tissues and commercialization of biological material provides a bridge to discussion of the moral dilemmas encountered in this field. Training future scientists to have a sincere appreciation of the ethical issues with tissue engineering may allow them, as future educators, to accelerate public acceptance of this field. Best of all, biomaterials science is not truncated to short, abbreviated chapters requiring supplementation by an additional text—there are seven full-length chapters on biomaterials. An additional biomaterials-related chapter that didn’t make it into the book, “Physico-chemical Properties of Synthetic Scaffolds” is still available on the Elsevier Web site. *Tissue Engineering* by C. van Blitterswijk is the best tissue-engineering textbook available at this time.

Audience

Students, faculty, researchers, all those interested in understanding the multidisciplinary facets of tissue engineering. Very accessible to those with little biological background. A valuable addition to university libraries.

Recommendation

Highly recommended.

Table of Contents

- Foreword
- Introduction
- 1. Stem cells
- 2. Morphogenesis, generation of tissue in the embryo
- 3. Tissue homeostasis
- 4. Cellular signaling
- 5. The extracellular matrix as a biologic scaffold for tissue engineering
- 6. Natural polymers in tissue engineering applications
- 7. Degradable polymers for tissue engineering
- 8. Degradation of bioceramics
- 9. Biocompatibility
- 10. Cell source
- 11. Cell culture: harvest, selection, expansion, and differentiation
- 12. Cell nutrition
- 13. Cryobiology
- 14. Scaffold design and fabrication
- 15. Controlled release strategies in tissue engineering
- 16. Bioreactors for tissue engineering
- 17. Tissue engineering for skin transplantation
- 18. Tissue engineering of cartilage
- 19. Tissue engineering of bone
- 20. Tissue engineering of the nervous system
- 21. Tissue engineering of organ systems
- 22. Ethical issues in tissue engineering

Multiple-choice questions

Index

Acculis Limited (Denmead, England), the leading microwave ablation system company in the United Kingdom, announced the international release of its pioneering Microwave Tissue Ablation system for the coagulation of soft tissue in open surgery. The FDA 510(k)-cleared device is the first microwave ablation system to offer large, fast spherical ablations from single needle placements, superseding the performance of lower-power RF or other current microwave ablation systems.

Bristol-Myers Squibb Co. (New York, N.Y.) announced Nordic Capital Fund VII and Avista Capital Partners have completed their acquisition of ConvaTec, a business unit of Bristol-Myers Squibb. For nearly 30 years, ConvaTec has been a pioneer in developing and marketing innovative wound therapeutics and ostomy-care products that have helped improve the lives of millions of people worldwide.

OmniGuide Inc. (Bridge, Mass.) announced the introduction of the new BeamPath Neuro™, the first flexible CO2 laser scalpel for neurosurgery. The BeamPath Neuro fiber provides surgeons with a precise, no-touch microsurgical tool for various central nervous system (CNS) procedures, including intracranial tumor surgeries, spine tumor surgeries, and transnasal pituitary surgeries. BeamPath Neuro is designed for operating near critical structures, for accessing difficult-to-reach regions of the brain and minimizing thermal injury to adjacent healthy tissue of the brain or spine. The clinical benefits of CO2 lasers for neurosurgery were recognized 30 years ago. However, prior to BeamPath, CO2 lasers could only be delivered through a large articulated arm system and were limited to “line-of-sight” procedures. As a result, for the past 20 years, CO2 lasers have rarely been used in neurosurgery.

Roche (Basel, Switzerland), a leading healthcare company, announced it has proposed to acquire the outstanding publicly held interest in Genentech (San Francisco, Calif.), a leading biotechnology company, for \$89 per share in cash, or a total payment of approximately \$43.7 billion to equity holders of Genentech other than Roche. Roche acquired a majority in Genentech in 1990 and currently owns 55.9 percent of all outstanding shares.

Sorin Group (Milan, Italy), the largest European cardiovascular company and world leader in medical technologies for cardiac surgery, announced the first patient enrollment in the e-Optima registry. The e-Optima registry is designed to assess the clinical performance of the Sorin Group Optima Drug-Eluting Stent (DES) Carbastent in the treatment of real-world patients in routine clinical practice. The Optima DES features a specially designed delivery system allowing for optimal DES expansion at implant. The registry will involve 1,000 patients throughout the world (except in the U.S. and Japan). Patients with multiple stenoses in multiple vessels will be allowed in the e-Optima registry, thus making it a real-world registry.

Other News:

In a recent study sponsored by AdvaMed on “Estimates of Medical Device Spending in the United States,” the authors reported the interesting, and to some degree unexpected, findings:

- Medical devices are a relatively small share of total national health expenditures (medical devices and *in vitro* diagnostics totaled \$111.7 billion in 2004)
- Over the 15-year period studied, medical devices remained fairly constant as a share of national health expenditures (5.4 percent to 6.1 percent from 1989 to 2004)
- Prices for medical devices grew more slowly than either the consumer price index (CPI) for medical services or the CPI overall (an average annual rate of 1.2 percent vs. 5.0 percent for MCPI and 2.8 percent for CPI).

The Food and Drug Administration is warning doctors against using Medtronic's Infuse bone-graft product in surgeries on neck bones, an off-label practice the agency never approved. The warning also covers OP-1 brand bone-graft products from Kalamazoo, Mich.-based Stryker Corp. For unknown reasons, using these products in the neck can cause dangerous complications, the FDA says. Infuse is a genetically engineered protein that causes the body to grow its own bone. It is meant to eliminate the painful procedure of harvesting bone from elsewhere in the patient's body to fill gaps.

At a meeting of the **U.S.-China Joint Commission on Commerce and Trade (JCCT)**, which concluded Sept. 16, 2008 in Yorba Linda, Calif., the two agencies involved in medical device regulation in China jointly announced they would no longer have separate testing, reporting, and inspection requirements for medical device manufacturers wishing to enter the Chinese market. The Agency for Quality Supervision, Inspection, and Quarantine and the State Food and Drug Administration also announced that separate requirement fees would be eliminated in favor of a single fee.

Community Calendar

55th Annual Meeting of the Orthopaedic Research Society

Las Vegas, Nevada • February 22-25, 2009

www.ors.org

35th Annual Northeast Bioengineering Conference

Boston, MA • April 3-5, 2009

www.nebec.org

Society For Biomaterials 2009 Annual Meeting and Exposition

San Antonio, TX • April 22-25, 2009

www.biomaterials.org

55th Annual Conference of the American Society for Artificial Internal Organs

Dallas, TX • May 28-30, 2009

www.asaio.com

Society For Biomaterials

2009 ANNUAL MEETING AND EXPOSITION

Grand Hyatt San Antonio • April 22-25, 2009 • San Antonio, Texas

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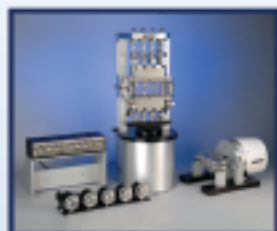
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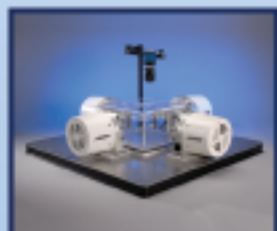
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