

BIOMATERIALS

FORUM



Fourth Quarter 2005 • Volume 27, Issue 4

**New Dues
Structure Introduced**

**Update on 2006
Annual Meeting**

**Burg Named
Forum Editor**



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BIOMATERIALS FORUM



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BIOMATERIALS FORUM



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To address the need for a multidisciplinary approach to the meeting, and to expand on the success of past joint sessions with other professional societies, the 2006 meeting will have significant scientific and social overlap with the Regenerate meeting of the Tissue Engineering Society International and PTEI (April 23-26, 2005). Both Program Committees are planning sessions of mutual interest and both societies are providing registration discounts and other incentives to promote cross-fertilization of these conferences. The goal is to reflect and enhance the diverse expertise and value of our membership. In short, this means more science, more networking and more fun for your conference dollar.



Pittsburgh, Pennsylvania, USA

10 New Biomaterials Group Leader Appointed for the National Institute of Standards and Technology's Polymers Division

Dr. Lori Henderson was welcomed as the new Biomaterials Group Leader in the Polymers Division of NIST's Materials Science and Engineering Laboratory (MSEL). She succeeds Dr. Newell Washburn, who is currently a faculty member in the Department of Chemistry and Biomedical Engineering at Carnegie Mellon University. Dr. Henderson came to NIST from North Carolina State University, where she had been collaborating on the start-up of a new Biomaterials-Biotechnology Center.

12 When Progress in Cardiovascular Devices Transforms the Way Medicine is Practiced

During the past 10-15 years, less-invasive treatments have started blooming, including laparoscopic surgery, percutaneous angioplasty, endoluminal stenting, and recently, clinical trials have been started to evaluate the possibility of replacing heart valves percutaneously. While perfecting products and procedures, the medical community has seen an emergence of new specialties in medicine, several of them dealing with the cardiovascular system.

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From the Editor

Thank you!



With this issue of the Forum and five volumes behind me, I will end my term as Executive Editor of *Biomaterials Forum*. Following the steps of Elaine Duncan, founder and first editor of Forum/Torch, and Russ Parsons, past editor of the Forum, a difficult task indeed, I assumed this role with the goal to increase the participation of members in the

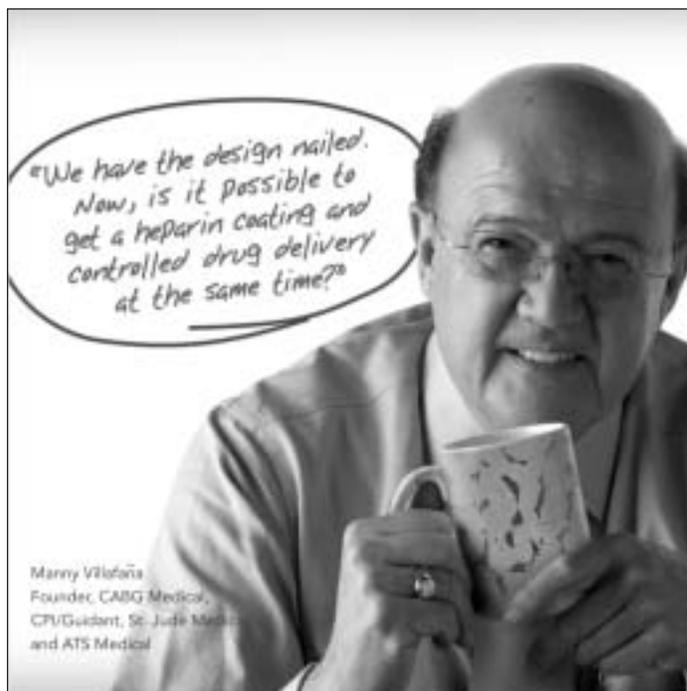
newsletter. Special Interest Groups and students were given a priority. Industry and academics shared columns and visions. Disseminating the image of a vibrant society as the building block of the medical industry was given great attention. With the help of a dynamic team of contributing editors and council members, the latest news from the biomaterials community was communicated to the members of the Society and to newsletter subscribers. Our mission was to promote communication and unity of purpose among the varied members of the Society, to promote communication between the leadership of the Society and members, to disseminate information regarding research and educational activities, and to promote initiatives and accomplishments of members that exemplify the role of biomaterials scientists and engineers in the community.

I sincerely thank all contributing editors for their tireless efforts to produce the newsletter and council members for their contributions to *Biomaterials Forum*. During the past five years, two Managing Editors worked with great dedication for *Biomaterials Forum*: Margaret Winchell and Frank Scussa. Their leadership and teamwork skills have been essential for delivering valuable information bimonthly, and more recently, quarterly, that hopefully made an impact. It has been a pleasure working with them.

Overall, it was a great privilege and honor to serve the members of the Society For Biomaterials for the past five years. I especially thank you for this opportunity.

Erratum

"Early Career Translational Research Awards by the Wallace H. Coulter Foundation to Society Members," Vol. 27, Issue 3, 2005. Please note that awards given to Thomas Webster and Karen Haberstroh will be assumed by Brown University in January 2006 rather than Purdue University as printed.



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Letter from the President

The Torch
By Michael V. Sefton

Dues down! Member value up!!



Elsewhere in this issue you will see announcements and articles regarding the new, much reduced dues structure for SFB. This structure has taken the concerted effort of several past presidents of the Society, publication chairs and a number of other key individuals working a number of years. I get to preside over the implementation, but the credit for this

strategically important achievement goes elsewhere.

It is, however, my responsibility to ensure that SFB capitalizes on the opportunity presented by membership dues that are more in keeping with other scientific societies. During the years we have lost many members because the fees were too high for the perceived “value.” Or there were other societies that provided a scientific environment at a better price than we could. Now we can compete.

The next step is a membership campaign to make sure all past members or past meeting attendees are aware of the new fees

(please tell all your colleagues). We need to recruit student members and make sure they stay with us.

But of course, and most importantly, we need to make sure that our services (meetings, journals, Web site) are of the quality that you deserve. Biomaterials is a critical technology in a new generation of medical devices, in biotechnology, and in regenerative medicine. We hear a lot about nanotechnology, but much of the excitement is at the interface between nanotechnology and biology—sounds like biomaterials to me. To this end, the SFB council has extended its annual mid-year meeting (mid-November) by a day to focus on key strategic issues. What is the role of the SIGs? How do we strengthen the quality of the annual meeting and make it the meeting to go to for the latest advances in biomaterials, tissue engineering, controlled release, nanotechnology, etc.? What other programs should we introduce to maximize value for you while maintaining an economical administrative infrastructure?

The dues go down and the value of membership goes up. If only our governments could use this lesson.

Karen Burg Appointed Editor of Biomaterials Forum

The Torch
By Publications Committee

On August 18, 2005, the Council of the Society For Biomaterials approved a recommendation from the Publications Committee to appoint Karen Burg as the new Executive Editor for *Biomaterials Forum*. She will assume her role with the 2006 volume of *Biomaterials Forum*. “I recognize the importance of *Biomaterials Forum* as the official newsletter of the Society For Biomaterials and want to give back to the Society that has supported my path from student to professor,” Burg said.

Burg joined the Society For Biomaterials as a graduate student in the early 90s and since then has continued to serve the Society diligently and innovatively. She has attained an international reputation in the field of biomaterials and tissue engineering. Her research was acknowledged through many prestigious national awards, including a PECASE award from the National Science Foundation and the Era of Hope Award from the Department of Defense, among many others. Her professional leadership skill in the Society For Biomaterials was recognized as: Publications Committee member (2001-2004);

Biomaterials Forum reporter for the Tissue Engineering Special Interest Group (2002-2003); Program Chair of the Cell Organ Therapy Special Interest Group (2003, 2004); Secretary/Treasurer of the Cell Organ Therapy Special Interest Group (2002-2003). During the last business meeting of the Society, she was elected member of the Awards and Nominations Committee for 2005-2006.

Her editorial skills have also been recognized nationally. Recently, Burg was named Editor-in-Chief of the *Journal of Histotechnology*, the scientific publication of the National Society of Histotechnology, which publishes original articles dealing with vertebrate histology or cytology, histochemistry, immunohistochemistry, electron microscopy, and molecular biology. She will assume this role in March 2006.

The Society For Biomaterials congratulates Dr. Burg and looks forward to working with her to assure that the members of the Society are well informed.

Staff Updates from Headquarters

The Torch

By Dan Lemyre,
Assistant Executive Director

Hello from the Society For Biomaterials headquarters! By providing a regular update of staff and membership activities, it is our sincere wish that all of the Society's members stay abreast of current Society activities, and we encourage more members to take an active role in the Society For Biomaterials. This quarter, headquarters staff has been active in their support of the following committee activities.

Awards Ceremonies & Nominations Committee

Headquarters received five nominations for new board of director officers and 34 award nominations. The Awards Ceremonies & Nominations Committee reviewed the nominations and is to make a recommendation to the board of directors in November.

Bylaws Committee

No bylaws changes are being considered at this time. If there are any members wishing to propose a bylaws change, please contact Tim Topoleski, SFB Bylaws Committee Chair, for details.

Devices & Materials Committee

The Devices & Materials Committee is seeking to work with ASM International to develop a materials database and is also coordinating SFB activities with ASTM and the ISO.

Education & Professional Development Committee

The Education & Professional Development Committee is working with student chapter leaders and headquarters staff to develop activities for the 2006 Annual Meeting in Pittsburgh.

Finance Committee

The Finance Committee has obtained approval from the board of directors on a new investment policy and is in the process of reviewing proposals from investment counselors. The Finance Committee is also working with staff to assemble the 2006 budget proposal for Council approval.

Long Range Planning Committee

The Long Range Planning Committee is working with headquarters staff to compile background information and prepare for a strategic planning meeting to be held in conjunction with this year's fall Council meeting.

Meeting Committee

The Meeting Committee is evaluating proposals from headquarters staff for the 2007 and 2009 meeting locations.

Membership Committee

The Membership Committee is developing proposals for increasing the value of SFB membership and directing headquarters staff in a marketing effort designed to promote the new SFB dues structure. For more information about the

new SFB dues structure and the lower dues rates for electronic journal subscribers, please see the article by Secretary-Treasurer Lynne Jones titled "Good News About Dues," or this issue's letter from the president.

Program Committee

The Program Committee is, as of this writing, soliciting abstracts for the 2006 Annual Meeting. The deadline for abstract submission is November 1, 2005. Work on the 2006 Annual Meeting will continue with the program planning meeting in December, and solicitation and review of proposals for revamped Technology and Training Forums! The 2006 Pittsburgh program promises to be an outstanding reflection of the diverse topics covered by the Society's membership, with an in-depth look into the many aspects of biomaterials: The Enabling Technology!

Publications Committee

The Publications Committee recently nominated a new Executive Editor for the *Biomaterials Forum*, who was confirmed by the board of directors. Karen Burg, from Clemson University, will be taking over the role from her colleague at Clemson, Martine LaBerge, who has served the Society in this volunteer capacity for five years. SFB staff would like to thank Martine for all of her hard work in training a new staff and welcomes Karen on board!

Special Interest Groups

Headquarters staff has recently completed updating the SIG officer handbook to assist the SIG officers in effective management. At the upcoming strategic planning meeting, the SFB board and Council will review how the Society can work with, and for, the SIGs to advance their mission to provide the leading forum to disseminate knowledge of biomaterials. To that end, a SIG survey has been conducted by headquarters with input from the SIG task force chair, Elaine Duncan. The results of the survey will be used by the Long Range Planning Committee in the forthcoming strategic plan.

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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Michael Sefton Named Fellow of the Royal Society of Canada

The Torch
From Press Release

On November 27, 2005, Michael Sefton, President of the Society For Biomaterials, will be inducted into the Royal Society of Canada (RSC) as Fellow of the Canadian Academy of the Sciences and Humanities. Michael Sefton was elected as a Fellow for his pioneering work in tissue engineering. He was the first to recognize the importance of combining living cells with synthetic polymers to create biological tissue and artificial organs—a field now known as tissue engineering. He is the inventor or co-inventor of many new ideas that are described in more than 10 patents, some of which are being commercially utilized for therapeutic purposes.

The Royal Society of Canada (RSC), the Canadian Academy of the Sciences and Humanities, has elected 60 new Fellows

and three foreign Fellows to its ranks. Election to the Royal Society of Canada is the highest honor that can be attained by scholars, artists and scientists in Canada. “The Society is now proud to celebrate the intellectual achievements of the new Fellows,” said Gilles Paquet, president of the Society. “We wish to recognize the extraordinary accomplishments of persons of talent, expertise and creativity in all fields, from experimental and applied science to health and medical sciences, and from social sciences and humanities to the various artistic domains.”

Congratulations to our President!

Buddy Ratner Named Michael L. and Myrna Darland Endowed Chair in Technology Commercialization

The Torch
From Press Release

Buddy Ratner, Past-President of the Society For Biomaterials, will be the first holder of the Michael L. and Myrna Darland Endowed Chair in Technology Commercialization. The chair was endowed “to attract and retain a distinguished faculty member in the Department of Bioengineering who has excelled in technology development and commercialization.”

Ratner was selected in recognition of his pioneering research and international leadership in biomaterials and outstanding mentoring programs. His contributions to understanding how biological molecules interact with surfaces of medical implants led to his 2002 election to the National Academy of Engineering. In 1996, he established an NSF Engineering Research Center, UW Engineered Biomaterials, to develop materials that improve the body’s acceptance of implants and to provide cross-disciplinary outreach.

With a PhD in polymer chemistry from Polytechnic Institute of Brooklyn (1972), Ratner held a postdoctoral position at the

University of Washington and then joined the Center for Bioengineering faculty in 1984. Honors include the Clemson Award for Contributions to the Literature (1988) and the Society For Biomaterials’ Founders Award (2004).

As Darland Chair, Ratner will be a lead instructor in the first course of the program on technology commercialization, which uses successful entrepreneurs to teach science and engineering students how to bring their innovations into the marketplace and succeed within existing companies.

“A committed advocate must shepherd a smart idea through the commercialization stage before it can help people,” Ratner said. “This generous endowed chair will help me train students for a new engineering environment.”

The Society For Biomaterials congratulates Dr. Ratner for this accomplishment.

Good News About Dues!

For many years, SFB members and many chairs of the Membership Committee have requested lower annual dues. This request has largely gone unfulfilled, in part due to the reality that our dues have been tethered to a subscription to *Journal of Biomedical Materials Research* (both editions). In our contract with the publisher, J. Wiley & Sons, each active and associate member of SFB is required to have an individual subscription to our journals. Therefore, our dues reflect both a fee that goes towards our Society's operating costs and the subscription fee. Recently, Wiley has introduced electronic versions of the journals that are available through the Internet. As a consequence, SFB has been able to negotiate a reduced rate for this e-journal that would still fulfill our obligation for a subscription. We are now able to offer our membership a new dues structure (see below) including an option for membership with the e-journal at a new rate of \$160/year U.S. The traditional option is still available (membership with printed journal) at the rate of \$250/year U.S.—a rate unchanged for 2006.

During the negotiations with Wiley, it became clear that a mutually beneficial goal for SFB and the publisher is increasing the SFB membership. A goal of 1,000 active/associate members has been proposed for the coming year. The SFB Membership Committee has been charged with renewing their

efforts to activate strategies to increase our Society's membership. This effort includes reacquainting members who have let their membership lapse with the benefits of participation in SFB, to novel ideas concerning additional services and value to our members. In this spirit, a new category of dues has been approved by the SFB board of directors and Council. This option includes a reduced membership fee (\$100) for associate members that have recently graduated from undergraduate and/or graduate programs and who choose the electronic version of the journal. It is hoped by offering this new dues category we will be able to better retain our student members as they transition into their new jobs in academia, industry, and the government.

We are extremely excited about these new options. Members can avail themselves of the new Internet-based version of the Society's journals while reducing the cost of their dues. Young graduates should be able to better afford continuing on with the Society. We think you will agree this is indeed Good News!

Hats off to Alastair Clemow and John Ricci for their roles in completing the negotiations with the publisher of *Journal of Biomedical Materials Research*.

Member Category	Location	Subscription	Dues
Active/Associate	All	Online	\$160
	US	Print	\$250
	Canada	Print	\$265
	Outside North America	Print	\$338
Associate Post Grad	All	Online	\$100
	US	Print	\$225
	Canada	Print	\$250
	Outside North America	Print	\$315
Retired/Senior	All	Online	\$50
	US	Print	\$200
	All	None	None
Student	All	Online	\$80
	US	Print	\$210

Biomedical Engineering Educational Summit II

University News
By Dave Puleo, University News
Contributing Editor

In March 2005, The Whitaker Foundation hosted its 2nd Biomedical Engineering Educational Summit (BEES). The objective of this and the first BEES, held in 2000, was “to help universities design and modify biomedical engineering programs to meet future needs.” Two days of workshops and invited lectures covered a variety of topics, ranging from teaching methods to ABET accreditation to special scientific material. Prior to the BEES, workshop chairs made available “white papers” that presented an overview of the subject matter and their views on core science topics that all BME students should understand, integration of the engineering sciences and modern biology, critical skills for undergraduate and/or graduate students, and engineering opportunities in the clinic. After the meeting, chairs prepared summary reports that included feedback and guidance from participants. Two workshops pertinent to readers of the *Biomaterials Forum*, tissue engineering and drug delivery, are briefly summarized in this article. The URL to source materials is shown at the end.

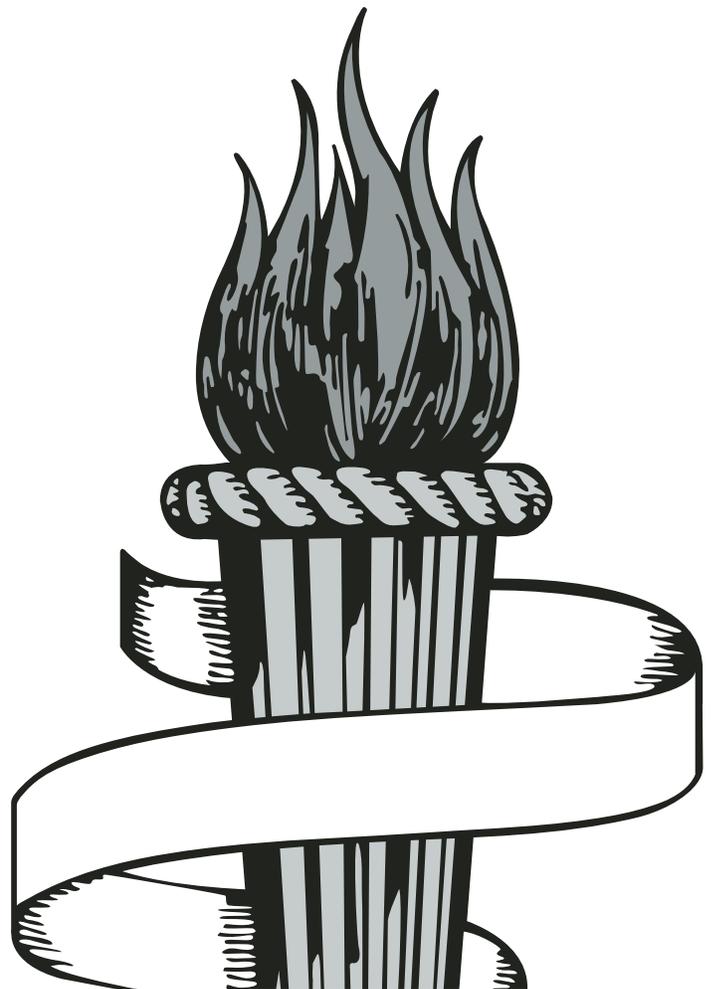
At BEES II, tissue engineering workshops were expanded to “tissue engineering and regenerative medicine.” The use of both terms reflects the common goal of creating functional three-dimensional tissues by manipulating individual cells. As such, the fields share certain common foundational science and engineering knowledge and skills. While it is easy to recognize progress in these areas requires people from different disciplines working together, it is more difficult to determine the preparation needed for students. Should students be required to have prerequisite biology or engineering subjects before taking a graduate subject in tissue engineering? Because graduate students often take a limited number of courses, there was some agreement that deficiencies in biology or engineering should be remedied, but specifying a firm set of courses was not appropriate. In classes dedicated to tissue engineering, vehicles for illustrating the complexity of the clinical problems or the approaches that can be taken should be given at the outset. For example, the course could be framed with a specific clinical problem (e.g., shortage of donor organs for liver transplant) or pair of problems (e.g., disease of a metabolic tissue and disease of a connective tissue). The examples would motivate the foundational science and engineering topics throughout the course. Skill sets (“toolboxes”) identified as being important for students working in these areas are problem identification, biology, cell engineering-analytical, cell engineering-experimental, and integrative engineering.

During the drug delivery workshops, a repeated theme was drug delivery is an appealing “real world” example of biomedical engineering. It is naturally translational and driven by patient needs. There was consensus that drug delivery is so central to the discipline of biomedical engineering, every biomedical engineer should know something about it. Yet, while some understanding is essential, full courses should not be required for undergraduates. In contrast, exposure in some detail was thought important for all graduate students. One workshop participant summarized the importance of drug delivery as

follows: almost every interaction of a patient with the health care system involves a drug, so it [drug delivery] is an unavoidable element of health care. A quick survey revealed a range of ways in which programs taught drug delivery, from stand-alone courses to one-third of a semester or year-long course. Topics that can be included in a typical course on drug delivery include mass transport, modeling of diffusion in tissues, analysis of biological barriers, compartmental models and pharmacokinetics, drug modification, drug delivery systems, and case studies.

With The Whitaker Foundation closing its doors in 2006, this may have been the last BEES. The international assembly of academic and industrial partners brought to bear tremendous experience with both the educational and commercial aspects of biomedical engineering. Overall, the white papers and summaries generated from the BEES will be useful for programs developing and refining their curricula to best prepare students to make contributions in these rapidly progressing fields.

Source: www.whitaker.org/academic/wrapup.html



A Note from the President

We would like to take this opportunity to welcome both returning and incoming graduate students. The SFB meeting in Pittsburgh is right around the corner so we wanted to give you a preview of what we the officers have been planning. We will have a student workshop that will focus on helping graduate students choose between a career in academia or in industry. This will be achieved through invited speakers sharing their knowledge and experience with us. This workshop will be divided into three sections. In the first section, we will focus on developing the students interviewing skills. In the second section, we will have invited speakers who have started in academia and switched to industry and vice versa. The third section will focus on how to develop a budget in both an academic and an industrial environment. We developed this workshop in part based on different requests from students at the meeting in Memphis. We are sure it will be an enriching experience and we hope to see you all there.

Biomaterials Bowl at Pittsburgh 2006

Plans are underway for the 2006 conference and we are hoping to bring a little competition to the scene with a Biomaterials Bowl! Both students and active members will have the chance

to show off their knowledge in different areas of biomaterials while getting to know each other a little better in a relaxed atmosphere. We will be asking for your involvement in generating questions and having members from your chapter compete so stay tuned for more details in the upcoming months!

Chapter Reports

By now your chapter should have submitted a chapter report to Marlon Ridley. If you have not done so, please contact him for a form at mridley@memphis.edu. Chapter reports will be used to determine student awards and highlight students on this page. Please be sure to get them submitted quarterly.

Fundraising Ideas

A major concern of most student chapters is how to raise the money for students to attend SFB conferences and other events. Here are a few new ideas from your fellow chapters:

- Michigan Tech organized a “blue-screen” photo booth for their annual Winter Carnival All-Nighter.
- Clemson designed and sold department static window decals to alumni, students, staff and faculty.

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Update on the 2006 SFB Annual Meeting

The annual meeting of the Society For Biomaterials has a long tradition of excellence in showcasing advances and cutting-edge technologies related to implant materials and devices. In recent years, the field of biomaterials represents the enabling technology to propel the progress of emerging strategies such as tissue engineering, nanotechnology, and the delivery of bioactive agents for treating, repairing and restoring function of tissues. Attendees at the Society For Biomaterials meeting reflect the multidisciplinary nature of the field and work every day to advance these topic areas by applying many of the lessons learned at the meeting to new clinical approaches. These new and challenging topics are not only related to basic and applied biomaterials research, but to the education and recruitment of new biomaterials scientists, engineers, and clinicians, and to the continued growth and development of the biomedical industry.

To address the need for this multidisciplinary approach and to expand on the success of past joint sessions with other professional societies, our 2006 meeting will have significant scientific and social overlap with the Regenerate meeting of the Tissue Engineering Society International and PTEI (April 23-26, 2005). Both Program Committees are planning sessions of mutual interest and both societies are providing registration discounts and other incentives to promote cross-fertilization of these conferences. Our goal is to reflect and enhance the diverse expertise and value of our membership. In short, more science, more networking, and more fun for your conference dollar and time!

These new and challenging topics are not only related to basic and applied biomaterials research, but to the education and recruitment of new biomaterials scientists, engineers, and clinicians, and to the continued growth and development

Abstracts are being solicited for the Society's general sessions at the 2006 annual meeting. These sessions cover the wide range of topics addressed by SFB's Special Interest Groups (identified in parentheses after the session title). The scope of each session listed is available on the SFB Web site. A general session is on a topic that is familiar to the general membership. Selected abstracts will reflect the most current research in that field.

- Biodegradable Hydrogels for Tissue Engineering (Tissue Engineering SIG)
- Fibrin Sealant and its Application in Tissue Engineering (Tissue Engineering SIG)
- Biomimesis in Drug Delivery (Drug Delivery SIG)
- Long-term Success of Dental Implants: Impact of Changes in Design, Clinical Protocol, and Surface Modification (Dental Craniofacial and Implant Pathology SIGs)
- Innovative Techniques in Biomaterials Education (Biomaterials Education SIG)
- Mechanobiology of Skin and Bone (Tissue Engineering SIG)
- Ophthalmic Drug Delivery (Ophthalmological Biomaterials SIG)
- Cell Response to Micro/Nanopatterned Biomaterials (Proteins and Cells at Interfaces SIG, Surface Characterization and Modification SIG)
- Urological Tissue Engineering and Biomaterials
- Surface Modification and Characterization of Biomaterials (Surface Modification and Characterization SIG)

Abstracts are being solicited for the symposia listed below. A symposium is designed to focus our attention on a specific topic within the large disciplines that make up the Society's membership. The symposium highlights a well-defined topic that is not addressed by the regular sessions of the annual meeting. These symposia also cover the wide range of topics addressed by SFB's Special Interest Groups (identified in parentheses after the Symposia title). The format includes a single lead speaker followed by related abstracts. The lead speaker either presents the current concepts of the topic or presents cutting-edge research within the area.

- Bionanotechnology: The Future of Biomaterials
- Clinical Relevance of Stent Fractures: Cause, Effect, and Improved Designs (Orthopedic, Dental/Craniofacial, Cardiovascular, Ophthalmological, Drug Delivery, Cell Organ Therapies, and Tissue Engineering SIGs)
- Modeling Bioresponse to Biomaterials (Biomaterial/Cell Organ Therapy SIG)
- Organic/Inorganic Hybrid Biomaterials (Dental/Craniofacial and Tissue Engineering SIGs)
- New Concepts and Challenges for the Delivery of Therapeutic Nucleic Acids (Drug Delivery SIG)
- Cellular Signal Transduction
- Stem Cells: Source, Culture and Application (Biomaterial/Cell Organ Therapy SIG)
- Advances in Biomaterials Science: A Tutorial Symposium by the Leaders of Biomaterials

Other Sessions Planned for the Annual Meeting

Workshops will be held April 26, 2006, during the day. The meeting's opening ceremony and reception will be held that evening. An additional registration is required to attend workshops and each registrant receives meeting notes prepared by the invited speakers. The purpose of a workshop is for the presenters to provide an in-depth educational experience on

Continued on page 15

New Biomaterials Group Leader Appointed for the Polymers Division at the National Institute of Standards and Technology

Feature

By Joy Dunkers, Contributing
Government Editor

Dr. Lori Henderson was welcomed as the new Biomaterials Group Leader in the Polymers Division of NIST's Materials Science and Engineering Laboratory (MSEL) in late January 2005. She succeeded Dr. Newell Washburn, who is currently a faculty member in the Department of Chemistry and Biomedical Engineering at Carnegie Mellon University. Lori came from North Carolina State University, where she had been collaborating on the start-up of a new Biomaterials-Biotechnology Center. Prior to this, she was a senior scientist and global project leader at Novozymes North America, a research supervisor at Akzo Nobel Coatings, and a research associate at BASF. Her technical expertise ranges from synthetic polymer chemistry and applied materials to molecular biology, protein chemistry, microbial physiology and enzymology. Her experience includes global collaboration and research developments in European countries through the EU commission. She received her PhD in polymer science at the University of Massachusetts Lowell with Professor Richard Gross. Her dissertation focused on kinetics and mechanism of enzyme-catalyzed polymerizations.

Lori was selected to lead a group that began in 2000 when the Dental and Medical Materials Group was renamed the Biomaterials Group. This change reflected the merging of a new program in regenerative medicine and the long-standing dental materials effort. The Biomaterials Group provides basic materials science, engineering, test methods, and standards to sectors of the health-care industry for the development of new or improved materials and delivery systems with a strong emphasis on tissue engineering and related technologies. Current project areas involve structure-property relationships in dental polymers and composites, combinatorial methods for rapid screening of biomaterials, and metrologies for tissue scaffolds. The group currently has 17 members consisting of permanent staff, postdoctoral fellows and guest researchers. Their research is acknowledged and supported by collaborative efforts with other government agencies, industry, academic institutions, and non-profit organizations. Following is a discussion with Lori about the Biomaterials Group in the Polymers Division.

What are your overall goals for the Biomaterials Group?

It is clear that rapid development of medical technologies depends on the availability of adequate methods to characterize, standardize, control, and mass produce them. To realize this goal, a measurement infrastructure is needed to bridge the gap between the exponentially increasing basic biomedical knowledge and clinical applications. The MSEL Biomaterials Program is a collaborative effort creating a new generation of performance standards and predictive tools

targeting the metrology chain for biomedical research. Additionally, today, all areas of materials science confront real systems and processes. In the biomaterials arena, we can no longer advance science by simply studying ideal model systems. We must comprehend complex realistic systems in terms of their structure, function, and dynamics over the size range from nanometers to millimeters. The Biomaterials Group is well positioned to take the lead in the development of a measurement infrastructure focusing on three emerging areas in regenerative medicine and tissue engineering: systems biology, bioimaging, and nanobiosensing. The primary goal is to utilize and advance our core strengths in materials characterization, multimodal imaging and visualization, and computational modeling to produce a new generation of performance standards and predictive tools as a design platform for future innovation and discovery in biomedical research. The other goals will include implementing strategies to enhance our knowledge, skills, reputation and professional standing in this field as a global leader in specific technology developments relative to the U.S. federal initiatives and other interagency activities.

One of the greatest challenges in a medical biomaterials program is the large number of related disciplines, from cellular and molecular biology to materials science to engineering. How do you plan to leverage very different areas of expertise?

As you mentioned, the increasingly complex nature of functional biomaterials demands a multidisciplinary approach to identify and develop strategies to characterize and control cell-material interactions. NIST is uniquely positioned to establish a framework outlining the critical interactions governing biomaterial research in these applications by focusing on establishing a "universal" language or vocabulary that best describes the outcome of discovery and development in this arena. We plan to leverage the different disciplines by implementing the measurement tools and laboratory procedures as better practices into academic curriculum (next generation innovators), other government laboratories, and industrial research and development (R&D). The key is improving communications and transferring technology through mechanisms targeting a variety of avenues such as standards reports, diverse journals, and lectures. There already exist a number of programs that realize the importance of cross-laboratory and scientific discovery validation needs like the biophysics, bioengineering, biosystems curriculum as well as the federal working groups such as the Multi-Agency Tissue Engineering group. Within the MSEL biomaterials program, I will continue to support this as well as partake in extracurricular activities to promote NIST's initiative in biosciences and health. Examples could include establishing a

global technology day, cross-discipline rotation, industry co-op programs, an industry liaison group, and an ex-pat program to study abroad. To facilitate the cross-fertilization and understanding within my own group, I draw upon my own long-term experiences in the different fields and global leadership skills to bring my diverse team to a common level of understanding.

Our job is metrology. What's your perspective on how metrology affects the consumer?

Tissue engineering and regenerative medicine will play a key role in sustaining health and reducing cost as our population grows and ages. In order to move beyond empirical trial and error into design, biomaterials development is in urgent need of reliable measurement standards and techniques. Industrial and regulatory sectors have already expressed a need for standards and new metrologies relating to properties of tissue scaffolds for regenerative medicine. We seek to meet these needs in several areas where the criteria are clear, and to help clarify industrial and regulatory needs in other areas where such clarification is required. Also, we are currently developing metrologies for quantifying and establishing the relationship between scaffolds and cellular response to assess the impact of morphology upon cell adhesion, molecular dynamics to safely host cytokines, and for quantifying mechanical stimulation requirements for cells, at the cellular level, from macroscopic inputs. All the above clearly demonstrates that such materials and tools will facilitate the understanding of factors guiding cell behavior, remodeling, etc. and hence result in the rationale design of materials for this field. The ability to modulate biological behavior and understand physiological states of cells are necessary early on in the research stage to

vastly reduce the R&D cost (labor, time, material expenses) while increasing the hit rate of products to market analogous to that witnessed by the pharmaceutical industry. Thus, NIST plays a vital role in the R&D pipeline.

What attracted you to NIST?

My first introduction and henceforth interest in NIST began during my quest to start a new biomaterials-biotechnology testing laboratory at North Carolina State University and Novozymes. The focus was on the adaptation of combinatorial methods for the rapid screening of genetically modified proteins and DNA. It was also prompted by the need for standards to verify and validate a multitude of analytical procedures in a multimillion-dollar grant sponsored by the Department of Energy. Of course, the Biomaterial Group's research had since caught my attention because of collaborations the Polymers Division had with corresponding professors and intermural programs.

It was also apparent after lecturing, reviewing the programs, and noting the business model upon which NIST operates, that the synergy between my academic and industrial training was extraordinary. There was no doubt that Eric Amis, chief of the Polymers Division, had taken on a challenge in a new biomaterials area whereby the merging of materials science and biosystems can lead to cutting-edge developments and other unprecedented opportunities.

Lori Henderson can be reached by e-mail at lori.henderson@nist.gov or phone at 301-975-4348.



Assistant Professor of Bioengineering Clemson University

Clemson University's Department of Bioengineering is seeking applications for one tenure-track junior faculty position in areas including cellular and molecular biology applied to regenerative medicine, bioinstrumentation, and biomechanics, to complement our well-recognized research and education program in biomaterials. We are seeking candidates possessing a Ph. D. degree in Bioengineering, Molecular Biology, Biochemistry, Electrical / Mechanical Engineering, or related disciplines. Additional post-doctoral research experience is desirable. Clemson University has selected Biomedical Sciences and Biotechnology as one of the emphasis areas and is dedicated to fostering growth in this area. The successful candidate will be expected to develop an active externally funded research program, initiate collaborative research with Greenville Hospital System, University Medical Center, and have a strong commitment to excellent teaching. Clemson University, located on Lake Hartwell in scenic upstate South Carolina, is a two hour drive from Atlanta, GA and Charlotte, NC, and enjoys a mild 4-season climate with low-cost-of-living. Applicants should send their CV, a statement of research and teaching interests, and the names of at least three references to Professor Naren Vyavahare, Search Committee Chair, Department of Bioengineering, 501 Rhodes Research Center, Clemson University, Clemson, SC 29634-0905. Email inquiries may be sent to: narenv@clemson.edu. Applications will be evaluated until the position is filled; however, to be assured full consideration, applications must be received by November 1, 2005.

When Progress in Cardiovascular Devices Transforms the Way Medicine is Practiced

Feature
By Julie Trudel,
Cardiovascular SIG

A former colleague of mine, during my first year working in industry, used to tell me “step back, look at the big picture. Now, what do you see?” I recently witnessed a very interesting (and animated) discussion between an interventional cardiologist and a cardiac surgeon. While I was listening to the debate, I caught myself looking at the big picture. What I saw involved myself and many of my colleagues from the Society For Biomaterials (SFB), especially those of us involved in the Cardiovascular Special Interest Group (SIG) and working on devices intended for minimally invasive procedures. The discussion happening before my eyes had to do with the respective roles of interventional cardiologists and vascular surgeons when it is time to operate on a patient suffering from chest pain. Not an easy question, considering that it involves some turf war between specialists.

During the past 10-15 years, less invasive treatments have started blooming, such as laparoscopic surgery, percutaneous angioplasty, endoluminal stenting, and more recently, clinical

Of course, given the choice between CABG or PCI, most of us would ask for PCI, as there is less surgical trauma (no need to crack open the chest; no need to harvest vessel segments in the leg or arm), improved cosmetic results, decreased length of hospital stay, faster recovery, and reduced cost. What is not clear in everyone’s mind, however, is how comparable the long-term results are.

A recent study published in *The New England Journal of Medicine* looked at 37,000 bypasses and 22,000 people who had stents (bare metal stents). They found that long-term survival was increased in patients having CABG surgeries. In addition, the need for a second procedure after the initial treatment was significantly lower in the groups treated with CABG (0.3 percent of CABG patients needed a second CABG done, while 27 percent of PCI patients had a second percutaneous intervention done within three years). While these numbers clearly speak in favor for CABG procedures, it is important to note that this study didn’t comprise patients being treated with

For us, biomaterials specialists and members of the medical device community, we want to develop new products and technology, and contribute to alleviating pain.

trials have been started to evaluate the possibility of replacing heart valves percutaneously. While perfecting products and procedures, the medical community has seen an emergence of new specialties in medicine, several of them dealing with the cardiovascular system.

Treatment of Occluded Coronary Arteries

In the era of drug-eluting stents (DES), cardiac surgeons are facing a decrease in cases of coronary artery bypass graft (CABG) procedures. Conventional CABG, which already had proven to be safe, effective, durable and reproducible, is very often replaced by a rising number of percutaneous coronary intervention (PCI) procedures involving either bare-metal stents or the newer drug-eluting stents. Indeed, during the past 10 years, CABG surgeries have fallen more than 20 percent. In 2003, the total CABG and PCI caseloads in the United States reached more than 1 million procedures. Seventy-five percent of patients received stents or angioplasties, while the remaining patients had a CABG procedure performed.

DES. Current data with commercially available DES indicate a much smaller rate of repeat interventions (below 10 percent). Longer-term safety and efficacy data are still needed as an increased frequency of late-stage thrombosis with DES is being observed when post-procedure antiplatelet therapy is prematurely discontinued.

There might also be patients for which CABG would be much better indicated than PCI treatment. For example, patients who are diabetic or have multivessel disease might better benefit from a CABG surgery. Indeed, results with DES in this patient population have not reached the single digit percentage point in restenosis after the first intervention. Some diabetic patients initially treated with stents and/or angioplasties still have occurrence of restenosis and need to face a CABG procedure. Arteries can become severely scared and damaged after multiple failed PCI interventions. What the medical community is asking is, “should a cardiac surgeon

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Abbott, Abbott Park, Ill., received U.S. Food and Drug Administration (FDA) approval for a minimally invasive device to treat patients with carotid artery disease, a risk factor for stroke. Abbott received FDA approval for the Xact® carotid stent and 510(k) clearance for the Emboshield® embolic protection system to treat patients at risk of stroke who are not favorable candidates for surgery. With this, Abbott becomes the second company to enter the U.S. carotid stent market. The new system features a stent specifically designed to treat diseased carotid arteries. The Xact stent is self-expanding and has a closed-cell design that creates a tightly knit yet highly flexible mesh intended to help restore the inner diameter of a carotid artery, promote a smooth inner vessel surface, and potentially reduce the release of fatty debris (emboli) from a diseased vessel when it is treated, which can lead to stroke. The Xact stent is designed for use in combination with the fully retractable Emboshield filter. Emboshield is designed to capture emboli that can break off during a carotid stenting procedure, and it is the only filter to feature Barewire™, a proprietary technology developed to allow for better control of stent placement once the filter is in place and fully apposed against the vessel wall.

Biosensors International Group Ltd. announced that it was granted a patent from the United States Patent and Trademark Office covering the technology behind its drug-eluting stents (DES). Specifically, this U.S. patent, (Patent Number 6939376) covers the use of anti-restenotic, immunosuppressive drugs including everolimus, in combination with a biodegradable drug-release polymer coating on an endovascular stent. The DES technology covered by this patent has clinically been shown to reduce restenosis in humans when compared to bare metal stents as demonstrated in the FUTURE I and II, and STEALTH clinical trials conducted by Biosensors. The patent also covers the technology used in the Company's flagship DES, BioMatrix™, which uses Biosensors' proprietary Biolimus A9™ drug, bioresorbable polymer, S-Stent™ and stent delivery catheter, all of which have been developed in-house. Biosensors also has other patents pending on the Biolimus A9 drug technology.

Boston Scientific Corp., Natick, Mass., received clearance from the U.S. Food and Drug Administration (FDA) to market its Flextome™ Cutting Balloon® dilatation device for the treatment of coronary artery blockages often resistant to conventional balloon angioplasty. The company plans to launch the product in the United States immediately. The product received CE Mark in Europe in January 2005. The Flextome Cutting Balloon device consists of a new balloon with three to four microsurgical blades (atherotomes) mounted lengthwise on its outer surface. When the device is inflated, the atherotomes score the plaque by severing the elastic and fibrotic continuity of the vessel with tiny incisions. Internal testing performed by Boston Scientific shows that the new Flextome Cutting Balloon is 30 percent more deliverable than its predecessor, the Cutting Balloon® Ultra2™ device, due to several design improvements, including an improved atherotome design, new balloon material and the use of the Maverick® catheter system.

Kensey Nash Corp., Exton, Pa., announced that the U.S. Food and Drug Administration (FDA) has allowed expanded indications of its BioBlanket™ surgical mesh. The expanded indications specifically allow the product to be used for the repair of hernias and reinforcement of soft tissue in rotator cuff repair surgery, two of the important target markets for the technology. The expanded indication also allows the product to be used in a wide variety of

other surgical procedures, including repair of defects in the thoracic wall, rectal, and pelvic floor reconstruction procedures, among others. BioBlanket is a Kensey Nash proprietary resorbable collagen sheet technology, intended for use in surgical procedures as a patch for reinforcement and repair of ruptured or damaged soft tissues. The potential target markets for the BioBlanket platform technology and other KNC proprietary sheet technologies are large. According to industry sources, hernia repair alone accounts for more than 600,000 procedures annually in the United States with a total potential market in excess of \$200 million. Rotator cuff injuries represent the single largest cause of shoulder instability and result in approximately 200,000 invasive procedures annually in the United States according to Medtech Insight. Repair of the dura in neurosurgical and spine procedures is currently projected at a market opportunity of greater than \$100 million and is one of the most active market segments in neurosurgery, according to industry sources.

Confluent Surgical Inc., Waltham, Mass., announced that a CE Mark has been granted for the DuraSeal sealant system for use as a surgical sealant during elective pulmonary resection as an adjunct to standard closure techniques of visceral pleural air leaks. By providing an airtight seal in lung surgery, DuraSeal will offer surgeons operating on the lung a valuable tool to prevent post-operative complications associated with alveolar air leaks. The DuraSeal technology is a patented synthetic, absorbable hydrogel delivered by a dual syringe applicator. The device can be stored at room temperature and prepared in less than two minutes. When sprayed on the pleura, a strong, adherent hydrogel is formed that effectively seals the suture or staple line within seconds. A feature unique to DuraSeal is the blue colorant that provides the thoracic surgeon excellent visualization of coverage and thickness of the material upon application to the lung. Postoperatively, DuraSeal continues to seal the resected site as healing progresses under the gel. After several weeks, the hydrogel breaks down into water-soluble molecules that are absorbed and cleared through the kidneys. There are about 300,000 lung resection procedures performed worldwide each year and about 80 percent of these cases result in at least some level of airleak. Additionally, Confluent Surgical currently markets the DuraSeal Dural sealant system for use as an adjunct to sutured repair of the dura in several countries, including the United States, and has established an extensive and distinguished neurosurgeon-focused distribution channel to represent the DuraSeal product in the U.S. market.

OsteoBiologics Inc., San Antonio, Texas, an innovator in tissue repair technologies, announced the commercial release of the TruTunnel™ Bone Graft Substitute Plug (TruTunnel BGS Plug). The TruTunnel BGS Plug can be used in certain ligament reconstruction procedures, such as for the anterior cruciate ligament (ACL), to fill voids and compress the graft to the tunnel walls. Designed to be used with other commercially available graft fixation systems, the implant provides additional graft stability and encourages tendon-to-bone healing. Many clinicians have expressed concerns with existing ligament reconstruction procedures, where excessive graft movement causes undesirable changes to the surgical sites. According to market estimates there are more than 250,000 ligament reconstruction procedures performed annually in orthopedic surgical procedures involving areas such as the knee, elbow and other joints. The TruTunnel BGS Plug utilizes OsteoBiologics proprietary PolyGraft® material technology and is unique by providing a biologically friendly and stable scaffold during the time required for tissue healing.

New Developments in Biomaterials at the NCBES, Ireland's Leading Biomedical Research Center

Feature
By Ita Murphy

The National Center for Biomedical Engineering Science (NCBES) at the National University of Ireland, Galway, is an interdisciplinary center of research excellence, which brings together scientists, engineers, information technologists and clinicians in a team-based, problem-centered approach to research. Established in 1999, the Center's research is focused on innovative therapeutic solutions to current medical challenges, including cardiovascular disease, orthopedics, reproductive medicine, and cancer.

The NCBES is a leading research center in the Republic of Ireland in biomedical engineering and hosts an internationally renowned biomaterials research cluster, with more than 35 researchers working in the biomaterials and tissue engineering research groups.

The focus of the tissue engineering group is the development of biomaterials for regenerative and clinical applications. This development and synthesis of biomaterials is accomplished by creating accurate *ex vivo*, *in vitro* and *in vivo* model systems for specific clinical applications. The novelty of this research lies in the understanding of biological and mechanical properties to customize unique biomaterials for specific clinical applications.

The group recently received funding for a three-year project, "A Scaffold for Treatment of Wound Healing in Recessive Dystrophic Epidermolysis Bullosa," from the EB charity dEBra Ireland. Dr. Gopinath Damodaran, who has joined the center from the Central Leather Research Institute, in Cehnnai, India, as a postdoctoral researcher on the project, has more than six years of research experience in the field of biomaterial development for wound healing applications. The project will involve collaborations with researchers at Aston University and Queen Mary's in London.

The tissue engineering group also collaborates with the gene therapy research cluster at the NCBES and graduate student Ailish Breen won best poster for her presentation on her project, "Modulation of Impaired Wound Healing Response by Nitric Oxide Synthase Gene Transfer and the Ability of a Biodegradable Fibrin Scaffold to Deliver a Therapeutic Gene," at the annual conference of the European Society for Gene Therapy in Tampere, Finland, last autumn. Ms. Breen's research is supervised by Prof. Abhay Pandit, leader of the tissue engineering group at the NCBES. Other projects in the group include: development of extracellular matrix based scaffolds, characterization of the microarchitecture of heart valve, *in vitro* development of living heart valve tissue models, a scaffold for nucleus pulposus regeneration, and development of functionally-graded porous metal scaffolds for spinal implants.

As well as these tissue engineering initiatives, other relevant questions in biomaterials are also being investigated, including:

development of thermoresponsive polymers, improvement of corrosion resistance of metallic implants, and understanding of cellular and biomolecular events after implantation of biomaterials.

The ethos of the NCBES is the cultivation of an interdisciplinary environment, with more than 130 scientists, engineers, IT specialists and clinicians working together to answer questions of scientific and clinical importance. The strength of the Center lies in the combined expertise, skills and creativity of a wide range of scientific, engineering and clinical disciplines, working side-by-side on challenging research programs.

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UK UNIVERSITY OF KENTUCKY

Faculty Positions, Center for Biomedical Engineering

The University of Kentucky Center for Biomedical Engineering is expanding its current foci in biomaterials/biomechanics and systems physiology. Outstanding individuals are invited to apply for three junior to mid-level tenure-track/tenured positions. The faculty members are expected to develop distinguished research programs and contribute to teaching and mentoring within the Center's graduate program. Of particular interest are investigators in the areas of tissue engineering and regenerative medicine applied to connective, cardiovascular, or neural tissues; integrative and translational research focused on molecular or cellular aspects of cardiopulmonary or nervous system diseases; and imaging of molecular and cellular processes. Especially desirable are investigators seeking to develop multi-investigator, interdisciplinary research programs that complement current faculty in the Center. New faculty members will benefit from the close proximity of the Colleges of Agriculture, Arts & Sciences, Dentistry, Engineering, Medicine, and Pharmacy and of the UK Hospital, all within a five minute walk. Applicants should submit a letter of application, CV, statement of research and teaching interests, and contact information for three references. Materials can be sent either electronically to cbmedgs@uky.edu or by postal mail to Search Committee, Center for Biomedical Engineering, Wenner-Gren Lab, University of Kentucky, Lexington, KY 40506-0070. *The University of Kentucky is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.*

When Progress..

(Continued from page 12)

instead of an interventional cardiologist initially treat these patients?"

Treatment of Occluded Carotid Arteries

Products intended for minimally invasive use in the carotid arteries are also affecting the medical profession. Traditionally, a vascular surgeon would operate in the carotid arteries. Interventional cardiologists are now handling catheters and stents in patients' carotid arteries. And this brings an additional turf war: interventional cardiologists, who successfully deploy stents in coronary arteries feel they can certainly do similar procedures in other places in the body such as in the femoral, coronary and renal arteries. Will there be enough work for everyone? Should vascular teams work together on patients? These are the kinds of issues specialists are facing.

Treatment of Brain Vessel Aneurysm

Interventional cardiologists are also treating brain aneurysms, using very small metal coils to fill the aneurysm sacs. Neurosurgeons who have been treating aneurysms for several years by clipping them share the same concerns as cardiac surgeons who have lost their CABG patients to interventional cardiologists. Surgeons worry their colleague interventionalists might have a bit too much of the cowboy attitude in their practice, especially since the long-term forecast for the treatments are not well documented.

Replacement of Defective Heart Valves and Cardiac Cell Therapy

As progress in medical devices, specifically catheter systems, takes place, these situations will keep happening. What better way to access various parts of the body than navigating the vascular system until you reach destination? Advance in percutaneous heart valve procedure will most likely create the same scenario, as it is on its way to commercialization. As long as the technology becomes user-friendly, the adoption rate could be surprisingly rapid. A similar situation could happen with the venue of cardiac cell therapy. Several groups are looking at ways to treat damaged areas of the heart percutaneously or transcatheterly by injecting cells and growth factors in the heart muscle with the hope to rejuvenate the affected tissue.

At the end of the day, physicians, regardless of their specialties, just want to do what is right for the patient. For us, biomaterials specialists and members of the medical device community, we want to develop new products and technology, and contribute to alleviating pain. Yes, we are part of this big picture, and it is to a certain extent because of our innovation that the face of medicine is evolving. Let's hope that all individuals involved find a way to live together harmoniously!

Update on the 2006...

(Continued from page 9)

topics relating to biomaterials with a significant amount of time dedicated to discussion and Q&As. The following workshops are scheduled for SFB's 2006 meeting in Pittsburgh:

- What Fits You Best, Academia or Industry, and How Do You Get There?
- Vascularization and Innervation of Tissue Engineered Constructs
- Microscopy: Basic Principles and Applications for Biomaterial Analysis

The purpose of a tutorial is to teach attendees about a specific technology or focus area. It may include up to two presenters and time for questions and answers. The invited speakers are selected for their experience in the field, as well as their ability to teach fundamental topics that are of increasing importance to a wide range of biomaterials scientists and engineers. Attendance at the tutorial is included with the general meeting registration. In 2006, the tutorial topics will be:

- Advancements in Surface Characterization Methods
- Product Liability Law as Part of the Product Design Process: What Every Scientist Should Know

Panel discussions are a format that foster open debate on a topic. The invited guests include renowned experts in the area of focus and the chair allows time for open discussion with the audience. The topics for 2006 are:

- Entrepreneurship and Biomaterials/Medical Devices
- Clinical Experience with Orthopaedic and Dental Biomaterials
- The Role Players in the Drama of Anti-biomaterial Immunity: The Macrophage, the Dendritic Cell, the B Cell and the T Cell

Please visit the meeting Web site often for updated information: www.biomaterials.org/Meetings/06AnnualMeeting/index.htm.

Community Calendar

Osteoarthritis Research Society International 2005 World Congress

December 8-11, 2005
Marriott Copley Place
Boston, MA
oarsi@oarsi.org
www.oarsi.org

Orthopaedic Research Society 52nd Annual Meeting

March 19-22, 2006
The Lakeside Center
McCormick Place
Chicago, IL
www.ors.org

The Minerals, Metals & Materials Society 135th Annual Meeting & Exhibition

March 12-16, 2006
Henry B. Gonzalez Convention Center
San Antonio, TX
www.tms.org

2nd International Conference on Epithelial Technologies and Tissue Engineering

April 3-4, 2006
Washington, DC
info@uweb.engr.washington.edu

Regenerate 2006

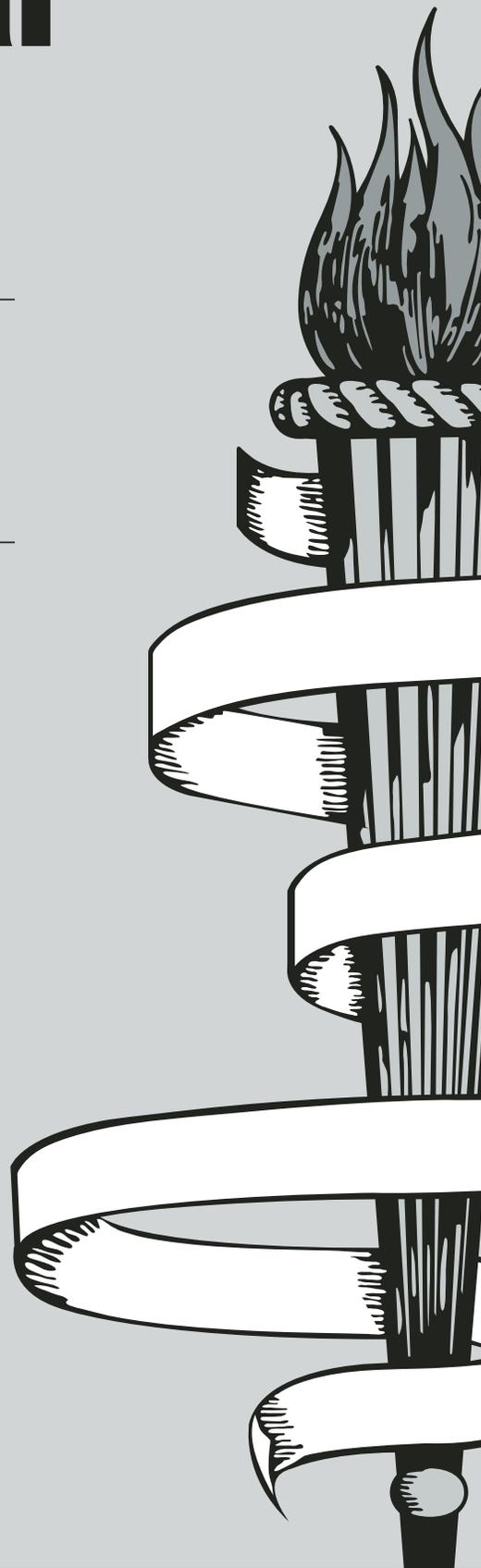
April 24-27, 2006
Westin Convention Center
Pittsburgh, PA
www.regenerate-online.com

Wound Healing Society 16th Annual Meeting & Exhibition

May 14-17, 2006
Double Tree Paradise Valley
Scottsdale, AZ
meetings@woundheal.org
www.woundheal.org

Controlled Release Society 33rd Annual Meeting & Exposition

July 22-26, 2006
Austria Center
Vienna, Austria
www.controlledrelease.org



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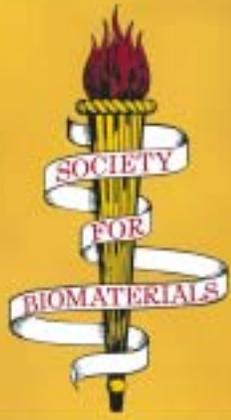
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Society For Biomaterials

2006 Annual Meeting

April 27 - 30, 2006
Pittsburgh, Pennsylvania



"Reflecting and enhancing the diversity and value of our membership"



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Society For Biomaterials

SFB

Please visit www.biomaterials.org
for updated meeting information.