SurFACTS in Biomaterials

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On My Microscopic Soapbox

By Steve Goodman

When I took over the helm of this publication a few issues ago I promised that I would bring more microscopy to this foundation. With a little stretch, I could even suggest that the "Frontiers in Tissue Imaging" symposium chaired by Klaus Wormuth for our upcoming annual meeting was in part my doing. But I won't.

Over the years, I have spoken to multiple audiences regarding microscopical analysis of biomaterials, and medical devices in general. In the last year, this has included workshops at Medical Device and

Greetings Continued on Page 17

BioInterface 2006 – A Travelogue

The San Mateo County Convention & Visitors Bureau and the San Mateo Marriott look forward to welcoming the Surfaces in Biomaterials Foundation to the heart of the San Francisco Bay Area.

Conveniently located just minutes away from the San Francisco International Airport (SFO), the Marriott offers easy access to downtown San Francisco, downtown Burlingame and other exciting

Travelogue Continued on Page 14

30 years ago, the biotech industry began here in Northern California. It started modestly at first, but with a sudden and dramatically increasing impact during the 1980s, Northern California moved to the front of a tidal wave of scientific advancement that changed the global landscape. The world today would be a wholly inferior place had it not been for the development of such necessities as insulin and our most vital treatments for the terrible diseases of our time like HIV, Cancer and Tuberculosis. In the life sciences industry as much as in society, Northern California believes it stands out as the preeminent location in the preeminent state in the preeminent country in the world.

Since 1990, BayBio has been walking side by side with the life sciences community of Northern California on the path to success. BayBio is an independent, non-profit 501(c)(6) trade association serving the life sciences industry in Northern California through advocacy, enterprise support, and the enhancement of research collaboration. BayBio is supported by organizations engaged in, or directly supportive of, research, development and commercialization of cutting-edge life sciences technologies.

Built by the founders of bio-

Bay Bio Continued on Page 4

ABSTRACT DEADLINE EXTENDED TO SEPT. 1

The program committee for BioInterface has extended the deadline for the submission of Abstracts until Sept. 1. For those interested in sharing their ideas and developments in the surface science, don't delay in submitting your Paper. Abstracts should be sent to the attention of Shannon Hicks at: ShannonH@Ewald.com

Supporting members also can display at the Applied Technology Workshop at no cost. Non-members are invited to participate and are asked to pay a $300 fee.

What's Inside

Opportunities in the Characterization of Vulnerable Plaque

By Klaus Wormuth

A significant fraction of the roughly 20 million people worldwide who experience a sudden cardiac event show no prior symptoms. A consensus document indicates that the risk to "vulnerable patients" of a sudden cardiac event comes from one or more of the factors categorized as "vulnerable plaque," "vulnerable blood," and "vulnerable myocardium." (Reference 1) Histopathology yields the properties of a "culprit plaque," one suspected of having caused a coronary occlusion, and indicates that about 70% of deaths are caused by ruptured plaques, and 30% due to non-ruptured plaques at which thrombosis occurs (Figure 1). However, the exact characteristics of "vulnerable plaque," plaque which might (but has not yet) caused a coronary occlusion, remain an open question since no representative animal models exist, and the properties of plaque are difficult to measure in vivo.

The possible markers of vulnerable plaque amenable to characterization fall into two categories: morphology and activity. (Reference 1) Some morphology characteristics are plaque cap thickness, lipid core size, stenosis, remodeling, color, collagen vs. lipid content (stiffness, elasticity), and the degree of calcification. Some activity characteristics are plaque inflammation, endothelial denudation, oxidative stress, superficial platelet aggregation, rate of apoptosis, angiogenesis, matrix digesting enzyme activity, and the presence of microbial antigens.

Since current diagnosis methods have significant limitations, opportunities for the development of medical devices to assess vulnerable plaques are manifold. Catheter-based devices which measure intravascular ultrasound absorption (IVUS) yield 3D images of plaque morphology, with calcification, fibrous tissue, and thrombus identifiable. (Reference 2) Radio frequency IVUS provides the most detailed information, helping to categorize plaques with and without lipid cores. Optical coherence tomography (OCT) uses light interferometry to image intima,

Characterization Continued on Page 9

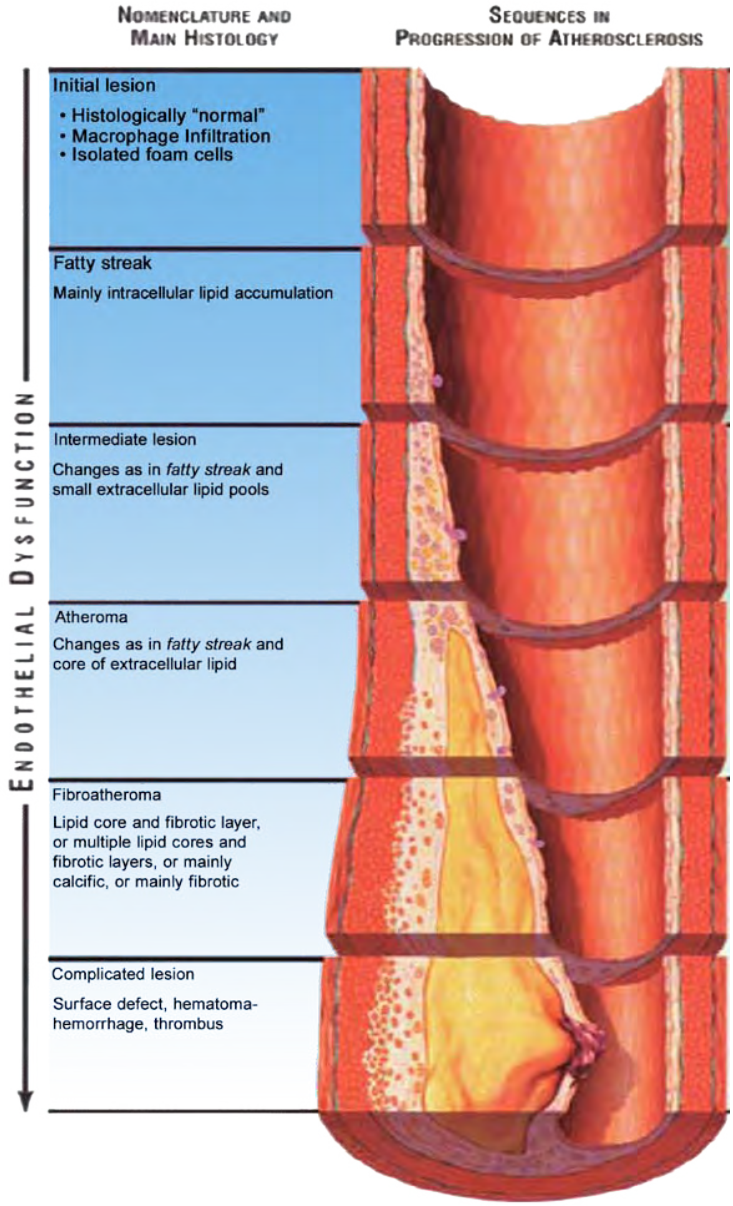


Figure 1

SurFACTS in Biomaterials is the official publication of the foundation and is dedicated to serving industrial engineers, research scientists, and academicians working in the field of biomaterials, biomedical devices, or diagnostic research.

CMS Proposes 35 Percent Cut in Reimbursements for Drug-Eluting Stents in Fiscal Year 2007

By Phil Triolo, PhD, RAC

The Center for Medicare and Medicaid Services (CMS) recently published its proposed hospital Inpatient Prospective Payment System (IPPS) for Fiscal Year 2007 (1). The most significant reductions in payments, which, if the proposed fees are finalized would take effect Oct. 1, 2006, would be for procedures utilizing drug-eluting stents (DES). Reimbursement for DRG (Diagnosis-Related Group) 557 for "Percutaneous Cardiovascular Procedure with DES with Major Cardiovascular Diagnosis," and 558 for "Percutaneous Cardiovascular Procedure with DES without Major Cardiovascular Diagnosis" would be reduced by 26% and 35%, respectively. Proposed reimbursements for these procedures in Fiscal Year 2007 is $11,320 for DRG 557 and $7591 for DRG 558.

The proposed changes in reimbursement have been widely criticized by industry groups, the medical profession, and consumer advocacy groups. A list of links of responses to the proposal, whose comment period expired on June 12, appears on AdvaMed's Web site (2).

The reason for the changes in reimbursement amounts is that the proposed payment system computes reimbursement fees based on hospital costs. The existing system uses hospital charges in its calculations. AdvaMed has prepared a white paper arguing that cost data can be out of date by the time CMS uses it because of the length of time it takes for hospitals to report these data and the time it takes CMS to analyze and use them in its calculations (3). Additionally, the data used in the calculated reimbursement scheme were incomplete. Data were not considered from all hospitals. AdvaMed argues that in order for the reimbursement fees to be accurate, data from all hospitals have to be considered.

Whereas AdvaMed advocates delaying implementation of any new payment scheme for a year, the Medical Device Manufacturers Association (MDMA) recommends that no changes be made until 2010 to allow stakeholders to fully analyze the proposal and CMS to assure that its reimbursement rates are based on the best available cost data (4).

The proposed IPPS also includes a recommendation for a change to "severity-adjusted" DRGs. DRGs are subdivided using age, the presence of comorbidities, and technological complexity as weighting factors to scale reimbursement. The proposed severity-adjusted DRG system focuses on the Severity of Illness (SOI) to weight reimbursement payments for a particular DRG. Age, comorbidities, and technological complexity, factors currently used to set reimbursement rates would be replaced by SOI as the sole factor influencing reimbursement. The disadvantage of the proposed change to the medical device community is that the use of complex technologies—which usually consist of innovative and often expensive devices—would not be considered in reimbursement decisions, providing a disincentive to their use.

Medicare payments account for roughly 1/3 of the dollars paid for medical treatments in the United States. A national decision by Medicare to cover a new medical technology, and the dollar amount assigned to reimburse the technology, are often used by local providers (e.g., insurance companies) in their coverage and reimbursement decisions. So, the proposed changes could have a significant effect on the reimbursements made for the use of devices by all providers, and will affect decisions on funding projects for the development of combination products and other new technologies.

References (All URLs were accessed on June 23, 2006)

1. Proposed Regulation CMS-1488P, Medicare Program; Proposed Changes to the Hospital Inpatient PPS and FY2007 Rates, available online at http://www.cms.hhs.gov/AcuteInpatientPPS/IPPS/list.asp
2. http://www.advamed.org/inpatient/index.shtml
3. http://www.advamed.org/publicdocs/5-12-06_whitepaper.pdf
4. http://www.medicaldevices.org/public/issues/documents/MDMA2007IPPSCommentLetter.pdf

2006 NESAC/BIO Surface Characterization Workshop

August 23-35, 2006

The 2006 NESAC/BIO Surface Characterization Workshop will be held at the University of Washington August 23-25, 2006. Learn to characterize the surface composition and structure of biomaterials. The workshop includes lectures and surface analysis demonstrations on NESAC/BIO instruments.

Attendees will be taught the capabilities of surface analysis methods and how to review data received from surface analysis laboratories. When you register for both the UWEB Summer Symposium and NESAC/BIO Surface Characterization Workshop you will receive a discount. For more information, contact nesacbio@u.washington.edu.

Bay Bio Continued From Page 1

technology, BayBio was established in 1990 by a consortium of life sciences executives, universities, public officials, and educators to foster a regional climate that nourishes the industry and the community surrounding it. In 2006, BayBio divided its activities into two organizations: BayBio and the BayBio Institute. BayBio focuses on improvement of business conditions in the industry and advocacy as a trade association, and the BayBio Institute focuses on life sciences educational efforts in Northern California. Members of BayBio come together for industry advocacy, networking, group purchasing, and to serve their community. As the life sciences association in Northern California, BayBio serves the region's 820 life science companies, a dozen private research institutes, nine regional universities, and public officials at all levels of government.

BayBio brings the life science community together by providing a forum for members to convene, interact, exchange information and ideas and address timely issues. A wide variety of BayBio standing committees offer members the opportunity to play a direct role in taking on challenges faced by the life sciences community every day. In all committees, BayBio works diligently to advance a broad industry agenda, building coalitions with stakeholders on federal, state, regional and local issues. BayBio serves as the voice of the life sciences industry to elected leaders.

Throughout the year BayBio brings original content focused on issues of public policy, industry best practices, and trends in innovation. With a variety of key industry events, including exclusive events for emerging companies, seminars and lectures, regional conferences and networking sessions, BayBio produces events for all industry needs. BayBio's Annual Conference focuses on the issues and trends in best management practices and presents a unique opportunity to discuss issues critical to industry survival. Also prominent among BayBio's activities is Gene Acres, the largest life sciences oriented facilities and operations conference in the nation and historically a signature event. Each year, BayBio hosts The Pantheon Awards Dinner, which brings together Northern California's life sciences industry leaders in a celebration of the region's achievements. BayBio also produces a Town Hall series for promoting critical thought that brings to the region the finest journalists, entrepreneurs, political thinkers, social activists, scholars, and critics of our time.

In addition, BayBio works every day to advance the industry through its purchasing consortium, a collective with more than $100 million in buying power. From lab supplies to employee benefits, BayBio provides core products and services on which every life sciences company can depend.

BayBio rounds out service to the industry by generating state-of-the-industry updates such as financial and political analyses, economic results and social impact studies. Key publications include: BayBio IMPACT, an annual publication documenting the effect that the Northern California life sciences industry has on patients' lives every day; BayBioNOTES, a monthly online newsletter focused on the life sciences in the region; BayBioINDEX, BayBio's tracking index of a basket of Northern California's life sciences companies and featuring market insights by BayBio's Economic Advisory Board; and the BayBio Directory, an annual publication providing detailed information on Northern California's life sciences companies.

All of BayBio's activities are a reflection of its membership. To become a member, visit www.baybio.org.

BayBio - By the Numbers

9	Counties
101	Cities
820	Companies
85,000	Number employed in Bioscience directly
250,000	Direct and indirect employees
5.8 Billion	Amount, in dollars, of wages paid

Encore Medical to Go Private With $870M Deal

From the Austin Business Journal

Encore Medical Corp. will go private in a newly-inked $870 million merger deal with a company controlled by Blackstone Capital Partners V LP. In the buyout, Encore's stockholders will get $6.55 in cash for each share of Encore common stock they hold — a 36 percent premium on Encore's Nasdaq closing price of $4.81 on June 30, 2006. On July 3, Encore's shares were trading for $6.28

The Proposed Change in Medicare Inpatient Reimbursement Expected to Impact Profitability of Specialty Hospitals

The recently published proposed change in inpatient Medicare payment is expected to have a significant financial affect on hospitals that specialize in cardiac and orthopedic services. On Thursday, April 14, 2006, the Centers for Medicare and Medicaid Services (CMS) released its Proposed Rule for the Inpatient Prospective Payment System. This proposed rule, issued in April each year, communicates updates to Medicare's inpatient payment system.

Medicare currently pays hospitals for inpatient hospital services on a rate per discharge basis that varies according to the DRG to which a beneficiary's stay is assigned. The formula used to calculate a hospital's payment for a specific case multiplies the individual hospital's established payment rate by the relative weight of the DRG to which the case is assigned. The relative weight of each DRG represents the average resources required to care for cases in that particular DRG, relative to the average resources used to treat cases in all DRGs.

In its proposed rule, CMS is proposing a two-step change to the DRG system. The first step, which would be effective for Fiscal Year 2007, would modify the current charge-based methodology used to develop the annual DRG relative weighting factors to a hospital-specific, relative-value (HSRV), cost-based system. CMS would establish "hospital specific charge-relative-unit weights at the cost center (HSRVcc) level to remove the bias introduced by hospital characteristics (that is, teaching, disproportionate share, location, and size, among others) and then [scale] the weights to costs using the national cost center charge ratios developed from the cost report data. After studying Medicare cost report data, [the agency proposes to establish] 10 cost center categories based upon broad hospital accounting definitions." There would be eight ancillary cost groups in addition to routine-day costs and intensive-care day costs, and each category represents at least 5 percent of the charges in the claims data.

The second step in the DRG modification process would be to increase the number of DRGs to better reflect the severity of resources used in treating Medicare beneficiaries. CMS indicates that this second step would be implemented "by FY 2008 and potentially earlier." CMS proposes to expand the DRG classification system using a consolidated version of DRGs based on 3M Corporation's all-patient refined (APR) DRGs to better account for severity.

CMS estimates that several high cost specialties will experience significant reductions in reimbursement. Cardiac care is expected to experience the greatest reduction in reimbursement as a result of the change to HSRVcc. Based upon projections, DRG 558—Percutaneous Cardiovascular Proc w Drug-Eluting Stent w/o Maj CV DX, is expected to experience the greatest decline in reimbursement at 32.9%.

Orthopedic procedures, specifically DRG 545—Revision of Hip or Knee Replacement are expected to experience a 7.7% reduction in payment. DRG 545 represents a group of joint revision procedures that due to the current cost of the implant and procedural expenses is inadequately reimbursed under the current DRG structure. As a result of the proposed changes, reimbursement for DRG 545 would be reduced even further.

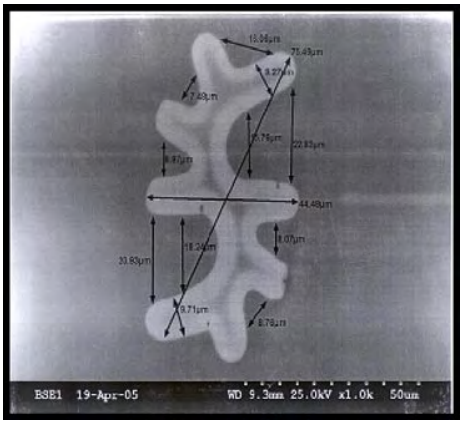
CMS expects the new cost-based DRG weighting system and consolidated severity adjusted DRGs to have the greatest impact on specialty hospitals. The Medicare Payment Advisory Commission (MedPAC) has defined a Specialty Hospital to be a hospital in which 1) 45% of Medicare discharges are either heart, orthopedic or surgical cases or 2) 66% of total cases are in two of the three categories (heart, orthopedic or surgical cases). For the last several years, specialty hospitals have been under review by CMS and

Medicare Changes Continued on Page 14

Innovative Polymer Fiber Solutions For Implantable Materials

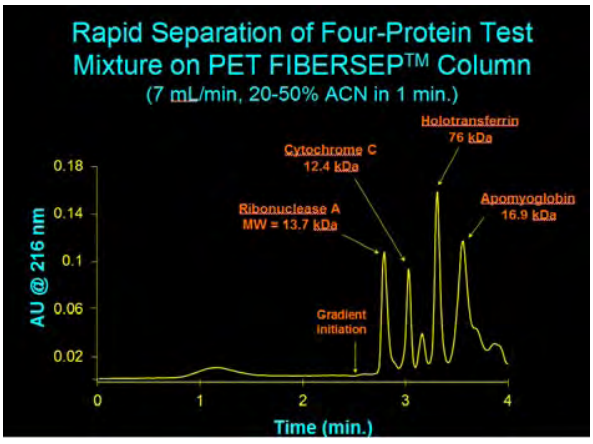
by Dr. Phil Brown

The School of Materials Science and Engineering at Clemson University prepares students to apply science and engineering principles to problems related to the understanding, characterization, and development of new technology necessary for the processing and manufacturing of different materials and related products. MSE has various research and teaching interests, but its primary concentrations include Textiles, Materials Science and Engineering, Fiber Science, and Polymer Science, offering degree programs in each of these specializations. The School of Materials Science and Engineering also maintains partnerships with several research groups at Clemson.



The anterior cruciate ligament (ACL) is composed primarily of fibroblasts and extracellular matrix organized in a parallel structural alignment consistent with their biomechanical function in resisting tensile loading. The ACL possesses limited capacity for intrinsic healing and regeneration, and therefore injuries require surgical reconstruction to restore joint stability and prevent the premature onset of degenerative joint disease. Capillary channel polymer (CCP) fibers possess a novel cross-sectional architecture that provides increased surface area relative to smooth fibers, as well as supporting the capillary-like transport of fluids. We are investigating the abilities of CCP fiber architectures (above) to support adhesion, growth, and organized alignment of fibroblasts and extracellular matrix. Our research is showing that novel uses of capillary channeled polymer fibers were successfully implemented and displayed better results than round fibers for, cellular attachment to the substrate, nuclei elongation along the axial length of the fiber, actin filament and philapodia production and organized collagen production. This work is being done in collaboration with Ken Webb, assistant professor in Bioengineering at Clemson University (funding NSF through CAEFF).

For CCP fibers in addition to the surface chemistry affected by the base polymer, there is a wealth of fiber post-processing that can be employed to generate more specific surface characteristics. The actual channel design can vary in size and shape. Capillary-channeled polymer fibers initially had predicted uses in general textile applications, i.e., the high volume low cost markets where the primary use was in liquid transport applications, such as towels, disposable diapers, feminine hygiene products as well as "stay dry" fabrics in athletic wear. Nevertheless other advanced applications can be introduced to exploit the specific inherent characteristics of the fibers. Due to the structural packing behavior of such fibers in columns or pipes capillary-channeled polymer (CCP) fibers present a novel platform for chemical separations from the micro to preparative scales. An example of how such fibers can be used in HPLC columns to effect protein separations is shown (right). Polymer substrates can be therefore chosen explicitly for, or tailored to, the type of separation required. Thus the potential of CCP fibers is now realized not as an "advanced towel" but as highly efficient fluid transport materials that offer real potential in chemical and biological separations. This work was done through funding from NSF through CAEFF in collaboration with Professor Ken Marcus, Department of Chemistry, Clemson University.



Other areas of Dr. Brown's interest are the fabrication of nanofibers devices and constructs via electrospinning. Recent work has investigated a method to make small-diameter bypass graft to replace a diseased blood vessel due to the progression of diabetes or the result of smoking. The problem arises that due to these chronic health issues, the patient's veins can no longer be used for such a procedure. While large artificial arteries (10 to 15 millimeters in diameter) have been in use for about 50 years for replacing large blood vessels, development of a small-diameter artificial artery (less than 5 millimeters) has been unsuccessful due to rapid failure when implanted. Smaller prosthetic arterial grafts, particularly those of small-diameter (< 5 mm internal diameter), continue to suffer high failure rates due to acute thrombosis (clotting). The work in this study involves electrospinning and this fabrication methodology has distinct advantages over other contemporary methods in

Polymer Fiber Solutions Continued on Page 9

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Board of Directors Nominations Open

The Board of Directors of the Surfaces in Biomaterials Foundation will fill the positions of President-Elect, Vice President, Treasurer and Secretary at the annual meeting at BioInterface 2006 in December. Vice President, Treasurer and Secretary are one-year terms. The president-elect effectively is a three-year term as that person becomes president then past-president in succeeding years.

Current officers of the foundation are: Dan Ammon, President; Victoria Carr-Brendel, President-Elect; Daniel Hook, Secretary; Lise Duran, Treasurer; Joe Chinn, Vice President; Jim Brauker, Past President. At the annual meeting, Carr-Brendel will become President and Ammon will become Past-President.

All supporting members and academic members in good standing may nominate candidates for the board. Applications can be found on the website at www.surfaces.org (under Awards & Nominations). Please fill out the application and include a letter of recommendation for the person that you are nominating. Nominees must be employed by a supporting member in good standing. Deadline for nominations is August 15. An officer must be from a supporting member of the foundation that is in good standing. Duties of the offices can be found at the website: www.surfaces.org (About the foundation, then by-laws).

Supporting members of the Surfaces in Biomaterials Foundation are:

Angiotech BioCoatings
Bacterin International, Inc.
Bausch & Lomb
Boston Scientific
Boston Scientific Cardiovascular
Carbomedics
Carmeda-BDSM
DePuy orthopedics
Dexcom
Evans Analytical Group
Genzyme Corporation
Harland Medical Systems
Medical Device Evaluation Center
Medtronic
Physical Electronics
Surface Solutions Lab, Inc.
SurModics
Terumo Medical Corporation
University of Arizona
University of Minnesota
University of Washington
W.L. Gore & Associates

Please submit candidates for the Board of Directors by Sept. 1

Wanted: Committee Volunteers

Strong associations are built by strong involvement from volunteers of member companies. The Surfaces in Biomaterials Foundation is in need of volunteers for the membership committee and the SurFACTS newsletter.

Membership committee volunteers will assist in identifying and soliciting companies that would benefit by becoming members of the Surfaces Foundation. You will work closely with other committee members to develop membership materials and contact prospective companies.

SurFACTS newsletter volunteers will help develop content ideas and gather news and information for the publication. SurFACTS is published quarterly. Volunteers will be asked to share their expertise and experience in areas where they are most familiar.

Please forward the names and email addresses of volunteers to Bill Monn at billm@ewald.com. Your information will be forwarded to the appropriate committee chair.

Call for Nominees: Excellence in Surface Science Award

The board of directors of the Surfaces in Biomaterials Foundation is seeking nominations for the prestigious Excellence in Surface Science Award. This annual award is given to the person who has made a significant contribution to the surface science world both through a single break-through idea or a body of work over a period of time.

Dr. Jack Bokros, president of Carbomedics, was last year's award winner. Bokros' efforts to proliferate the use of pyrolitic carbon through education and working with numerous partners have made the material ubiquitous in mechanical heart valve applications.

Please forward nominations at your earliest convenience, but no later than Aug. 15, to Bill Monn at billm@ewald.com.

Check us out online!
www.surfaces.org

Polymer Fiber Solutions Continued From Page 6

that: 1) several polymers can be readily mixed and extruded using solvent system, 2) parameters for nanofibers formation can be controlled, 3) bioactive agents can be synthesized simultaneously with synthetic polymers and 4) devices can be directly fabricated. The goal of this study is to evaluate the effects of electrospinning small diameter grafts (below) while combining several different components (e.g., PET, polyurethane and collagen). Our hypothesis is that by combining these particular components a novel composite biomaterial with increased biocompatibility (i.e., circumferential compliance, porosity and low water permeability) will be created. This work is being done in collaboration with Mr. Matthew Phaneuf (President and CTO of BioSurfaces) and Dr. Martin Bide (Professor in the Department of Textiles, Fashion Merchandising and Design at the University of Rhode Island). Funding for this research is provided from a Small Business Innovation Research (SBIR) Phase I/II grant awarded from the NIH to BioSurfaces (2R44 HL074771).

For additional information, please contact:

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Dr. Phil Brown is an Assistant Professor in the MSE Department. Dr. Brown's expertise is in the spinning, processing and modification of organic polymer fibers including the fabrication of fiber based devices and constructs. His current areas of research involving 8 PhD students and 2 post-doctoral workers are working across a broad base of fiber related subjects including, ultra-hydrophobic fibers, design of a novel ACL ligament, filtration fabrics from natural materials, small diameter artificial artery constructs, hollow alginate fibers for cellular encapsulation, molecularly imprinted fibers, fibers for chemical and biological molecule separations, flame retardency on polyester fibers treated with silicones and fibers for energy storage.

Characterization Continued From Page 2

plaque and lipid pools, and differentiates fibrous tissue from calcium. OCT offers better spatial resolution (2-30 microns) than IVUS (about 100 microns), however, the penetration depth of OCT is low, and blood absorbance interferes with the signal.

IVUS and OCT sense morphology, thermal probes can sense the temperature rise associated with the inflammation in plaques, but catheter-based Raman spectroscopy probes probably present the greatest potential to quantify the chemical composition of plaques, in that Raman spectroscopy can identify the relative amounts of cholesterol, triglycerides, phospholipids, elastin, and calcium salts in plaque. (Reference 3) While proven in vitro, the Raman method awaits further development to become a practical in vivo.

In the design of catheter-based probes, all of the conventional material/tissue biointerface issues arise: biocompatibility, deliverability, in addition to the challenge of maintaining sensing ability. Come hear Dr. Robert S. Schwartz speak about vulnerable plaque characterization at the "Frontiers in Tissue Imaging" session at the Biointerface 2006 meeting in Santa Clara.

References:
1) Naghavi, M. et al., *Circulation* 2003, 108, 1664
2) El-Shafei, A. and Kern, M., *Journal of Invasive Cardiology*, 2002, 14, 129
3) van de Poll, S. W. E. et al., *Heart* 2003, 89, 1078

Stents Trump Balloons for Restoring Blood to Ischemic Limbs

There may be light at the end of the tunnel for diseased superficial femoral arteries, which have routinely frustrated endovascular interventions. A self-expanding, nitinol (nickel-titanium) stent demonstrated significant efficacy in patients with severe claudication or chronic limb ischemia, reported Martin Schillinger, M.D., and colleagues of the Medical University of Vienna in the May 4 issue of *The New England Journal of Medicine*.

At six months the restenosis rate by intention-to-treat analysis was 24% in the stent group versus 43% in a balloon angioplasty group (P=0.05), they wrote. At 12 months the results were more impressive: 63% versus 37% (P=0.01) as assessed by duplex ultrasonography, wrote Dr. Schillinger and colleagues.

The authors noted that nitinol stents are stronger and more flexible than stainless steel stents and may be uniquely suited to the superior femoral artery, which is subject to significant stress from surrounding muscles—pressure that is known to crush and fracture stainless steel stents. The stent fracture rate in this study was 2%, versus an 18% fracture rate in previously published studies with stainless steel stents.

"Nature's strongest glue" found

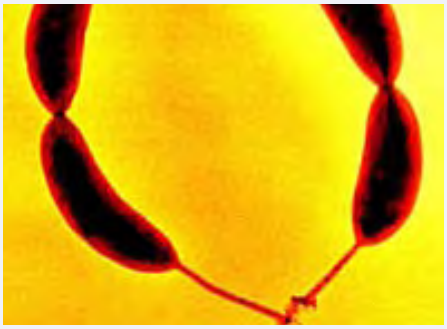
Scientists believe a bacterium that lives in rivers, streams and aqueducts could be nature's strongest glue

From BBC News

The US team hope the bacterium, Caulobacter crescentus, could be mass produced and used in medicine perhaps as a surgical adhesive or dental glue.

Indiana University researchers found it withstood a stress of five tons per square inch.

The report on the research appears in the *Proceedings of the National Academy of Science*.



Caulobacter sticks to things through chains of sugar molecules

Caulobacter crescentus affixes itself to rocks and the inside of water pipes via a long, slender stalk which is held fast with chains of sugar molecules or polysaccharides.

The Indiana team found these sugars were the source of its ultra-stickiness.

In experiments the team allowed the bacterium to attach itself to the side of a thin, flexible glass pipette.

They then tried to pull it away from the pipette and measured the force of the strain.

In 14 trials they found they had to apply a force of 0.11 to 2.26 micronewtons before the bacterium was detached.

Dental glue

This is seven times the force by which geckoes stick to slippery rocks through the very thin adhesive hairs on their feet—previously thought to be the stickiest naturally occurring material.

Bacteriology Professor Yves Brun said: "If you were to cover the tip of the finger with this glue you should be able to bond to an object weighing 1,600 pounds."

He said a man-made form of the bacteria could be especially useful in medicine and engineering as it worked on wet surfaces.

"One possibility would be as a biodegradable surgical adhesive perhaps used to close up wounds or as a dental adhesive.

"The challenge would be to produce large enough quantities of this glue

Glue Continued on Page 15

University of Washington Engineered Biomaterials is proud to present

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Or contact us: info@uweb.engr.washington.edu

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National Institute of Diabetes & Digestive & Kidney Diseases

2006 NESAC/BIO WORKSHOP

Surface Characterization of Biomaterials

August 23 - 25, 2006

National ESCA and Surface Analysis Center for Biomedical Problems
University of Washington, Seattle, Washington

Learn to Characterize Biomaterial Surface Composition and Structure

The National ESCA and Surface Analysis Center for Biomedical Problems (NESAC/BIO) is a state-of-the-art surface analysis center whose mission is the development and application of surface analysis methods for biomedical research.

This NESAC/BIO Surface Characterization Workshop includes lectures and surface analysis demonstrations. Demonstrations on NESAC/BIO instruments will provide application examples for the material covered in the workshop lectures. Attendees will learn the capabilities of surface analysis methods and how to intelligently review data received from surface analysis laboratories. The workshop will focus on the following methods:

- Electron Spectroscopy for Chemical Analysis (ESCA)
- Secondary Ion Mass Spectrometry (SIMS)
- Scanning Probe Microscopy (SPM)
- Sum Frequency Generation (SFG)
- Near Edge Xray Absorption Fine Structure (NEXAFS)
- Multivariate Data Analysis
- Contact Angle Measurements
- Surface Modification
- Surface Plasmon Resonance

For More Information: http://www.nb.engr.washington.edu/home/workshop/

TO Register: https://www.engr.washington.edu/epp/Scb/registration.html
Email: uw-epp@engr.washington.edu

NESAC/BIO is funded by NIBIB , NIH Grant # EB002027

NESAC/BIO Postdoc Roger Michel operating the 7200 Time-of-Flight SIMS Instrument

Calling all Exhibitors

We are in the process of contacting all Exhibitors from BioInterface 2005 to make sure they have an opportunity to be part of BioInterface 2006 this December in San Mateo.

It's not too early to make sure that you have reserved Dec. 4-6 for the annual conference and to get your reservation to exhibit at the conference. BioInterface continues to be an outstanding once-a-year opportunity to network with the best prospects for products and services in the surface science industry.

For more information on exhibiting or to make your reservation, contact Shannon Hicks at shannonh@ewald.com Or, call the Surfaces offices at 651-290-7476.

Student Poster Deadline Approaching

Students interested in winning a $1,000 prize should make sure that they submit a poster no later than Aug. 26. Students will present at BioInterface 2006 in San Mateo on Dec. 5. The prize winner will be announced during the conference.

Interested students should contact Shannon Hicks at shannonh@ewald.com or phone 651-290-7476.

BioInterface 2006 Preliminary Schedule

Monday December 4, 2006

WORKSHOP: Delivery of Therapeutic Biologics

7:00 - 8:15	Registration & Breakfast
8:15 - 8:30	Welcome and Introduction
8:30 - 10:00	Workshop
10:00 - 10:30	BREAK
10:30 - 12:00	Workshop continued
12:00 - 1:00	LUNCH
1:00 - 3:15	Workshop continued
3:15 - 3:45	BREAK
3:45 - 4:45	Panel Discussion
5:00 - 5:30	Applied Technology Workshops
6:00 - 7:30	Welcome Reception & Keynote
6:30 - 7:00	Keynote Speaker: Alan Hoffman

Tuesday December 5, 2006

7:30 - 9:00	Registration
7:30 - 8:00	Poster Session
8:00 - 8:45	Student Poster Session Judging
9:00	Welcome
9:15 - 11:00	Frontiers in Tissue Imaging
11:00 - 12:30	Neurovascular
12:30 - 1:45	LUNCH
1:45 - 3:15	Student Town Hall Business Meeting Biointerfacial Aspects of Tissue Engineering Applications
3:15 - 3:45	BREAK
3:45 - 5:45	Rump Session: Therapies of the Future: Tissue-Based or Device-Based?

Wednesday December 6, 2006

8 :00 - 4:00	Student Poster Session
9:00 - 10:50	Peripheral Vascular
10:50 - 11:05	BREAK
11:05 - 12:35	Orthopedics
12:35 - 2:00	AWARDS LUNCHEON Excellence in Surface Science Award Student Poster Award
2:00-4:00	Student Invention Symposium

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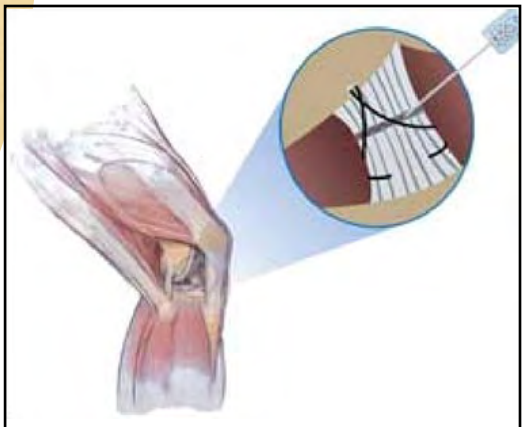
Getting ACL tears to heal themselves

A surgeon at Children's Hospital Boston may have found a better way to repair tears to the anterior cruciate ligament (ACL), a knee injury suffered by more than 100,000 Americans each year, particularly teenage girls. In the April *Journal of Orthopaedic Research*, orthopedic surgeon Martha Murray, MD reports that a collagen gel, enriched with blood platelets, can stimulate natural healing of a partial ACL tear, encouraging the body's cells to fill in the defect and restore mechanical strength to the ligament.

"This is a first important step in showing that the ACL can heal if we give it the right conditions," Murray says. "That's an important shift from thinking that the ACL has to be completely replaced after an injury."

ACL injuries are notorious for not healing well. Epidemic among teenage girls -- who are five times likelier than boys to tear the ligament -- they typically occur during sports that involve jumping and pivoting, like soccer or basketball. ACLs are currently reconstructed by replacing the torn ligament with a tendon graft. This painful operation allows patients to return to sports after significant rehabilitation, but it does not fully restore knee mechanics, and does not prevent arthritis from developing years later.

Working with an animal model of a partial ACL tear, Murray's team inserted a collagen gel, mixed with platelet-rich blood plasma, into the wound. The gel provided a physical "bridge" between the torn ligament ends, while the platelets churned out a variety of growth factors. Compared with untreated knees, knees treated with the gel showed greater defect filling at 6 weeks (43 percent versus 23 percent). The gel-treated ACL defects also had a 40 percent increase in mechanical strength at 6 weeks, compared with just 14 percent for untreated defects.



Murray envisions a simple outpatient procedure for repairing ACL tears: injection of a collagen gel, mixed with the patient's own platelets and plasma, via a small knee incision. [Image: P. Bibbins]

Until the 1970s, surgeons tried to repair ACL tears by sewing the ligament ends back together, but the sutures nearly always failed. Murray, who became interested in ACL healing while pursuing a doctorate in materials science,

Healing ACL Tears Continued on Page 15

Travelogue Continued From Page 1

venues. Hotel guests can enjoy an outdoor swimming pool and fitness facilities, a choice of on-site dining options including California Bar & Grill, Marketplace Deli serving Starbucks Coffee, as well as several restaurants within walking distance.

With mild temperatures averaging in the 50s in December, the San Francisco Peninsula provides the perfect backdrop for outdoor recreation. Enjoy nearby downtown Burlingame and San Mateo, lined with shops, coffee houses, breweries and a variety of restaurants to tempt every taste bud. Discover some of the area's unique museums, such as Coyote Point, a living museum of Bay Area wildlife, or the Hiller Aviation Museum, which chronicles the history of flight. Take a drive along the Peninsula's scenic coastline, with miles of unspoiled beaches, parks, boutiques, art galleries, restaurants and spectacular golfing.

Plus, the sites and sounds of downtown San Francisco are minutes away and easily accessible via the Bay Area Rapid Transit (BART) commuter rail system. The Marriott provides complimentary shuttle service to BART's SFO station. Plan to arrive a few days early or stay a little longer to explore some of San Francisco's major attractions, including Fisherman's Wharf, Alcatraz, Union and Ghiradelli Squares and Chinatown just to name a few.

Medicare Changes Continued From Page 5

MedPAC since it has been believed that specialty hospitals focusing in either cardiac or orthopedic procedures have been overcompensated by the Medicare DRG reimbursement system.

CMS expects the new systems to reduce reimbursement to cardiac specialty hospitals by 11.7% and orthopedic specialty hospitals by 9.4%. It is CMS and MedPAC's belief that the over-compensation to specialty hospitals has contributed to the growth in the number of new facilities. CMS states in the proposed rule "MedPAC also found that relative profitability ratios were higher among cardiovascular surgical DRGs than the medical DRGs. We believe the relative profitability of the surgical cardiovascular DRGs has been an important factor in the development of specialty heart hospitals. Our payment impact analysis indicates that this issue will be addressed by adopting HSRVccs."

We therefore predict that if these new payment modifications go into affect, cardiac and orthopedics services will become less profitable resulting in a reduced the incentive for the development of specialty hospitals.

Print me a heart and a set of arteries

From the New England Science Magazine

Sitting in a culture dish, a layer of chicken heart cells beats in synchrony. But this muscle layer was not sliced from an intact heart, nor even grown laboriously in the lab. Instead, it was "printed," using a technology that could be the future of tissue engineering.

Gabor Forgacs, a biophysicist at the University of Missouri in Columbia, described his "bioprinting" technique recently at the Experimental Biology 2006 meeting in San Francisco. It relies on droplets of "bioink," clumps of cells a few hundred micrometers in diameter, which Forgacs has found behave just like a liquid.

This means that droplets placed next to one another will flow together and fuse, forming layers, rings or other shapes, depending on how they were deposited. To print 3D structures, Forgacs and his colleagues alternate layers of supporting gel, dubbed "biopaper," with the bioink droplets. To build tubes that could serve as blood vessels, for instance, they lay down successive rings containing muscle and endothelial cells, which line our arteries and veins. "We can print any desired structure, in principle," Forgacs told the meeting.

Other tissue engineers have tried printing 3D structures, using modified ink-jet printers which spray cells suspended in liquid (New Scientist, 25 January 2003, p 16). Now Forgacs and a company called Sciperio have developed a device with printing heads that extrude clumps of cells mechanically so that they emerge one by one from a micropipette. This results in a higher density of cells in the final printed structure, meaning that an authentic tissue structure can be created faster.

Cells seem to survive the printing process well. When layers of chicken heart cells were printed they quickly begin behaving as they would in a real organ. "After 19 hours or so, the whole structure starts to beat in a synchronous manner," says Forgacs.

Healing ACL Tears Continued From Page 14

wondered why this was so, and eventually went to medical school to pursue the problem. Ligaments should, in theory, heal easily—they are made of fibroblast cells, which are workhorses in the body and easy to grow.

Examining torn ACLs at the microscopic level, Murray and colleagues were surprised to find that the ligament tries valiantly to heal itself—cells migrate to the wound, growth factors are secreted and blood vessels grow to nourish the new tissue. But the ligament ends never join. What s missing, Murray realized, is something to bridge the gap.

In the future, Murray hopes to extend her technique to other injuries like meniscus and rotator-cuff tears. Her ultimate dream is cartilage regeneration to repair joints damaged by osteoarthritis. No one has yet been able to repair cartilage, but Murray has discovered that even in bad osteoarthritis, cartilage has active, proliferating cells. She hopes to find another scaffolding material that would coat the pitted surface of damaged cartilage and recreate a smooth, nearly friction-free surface—like filling in potholes in a road.

"The cells are trying to find structure, but they just don't have it," Murray says. "They need a thing to move into; a place to live."

The current study was funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases, the National Football League, the Orthopedic Research and Education Foundation and the Orthopaedic Foundation of Children's Hospital Boston.

Glue Continued From Page 10

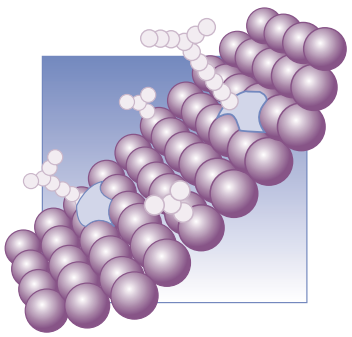
without it sticking to everything that is used to produce it," he added.

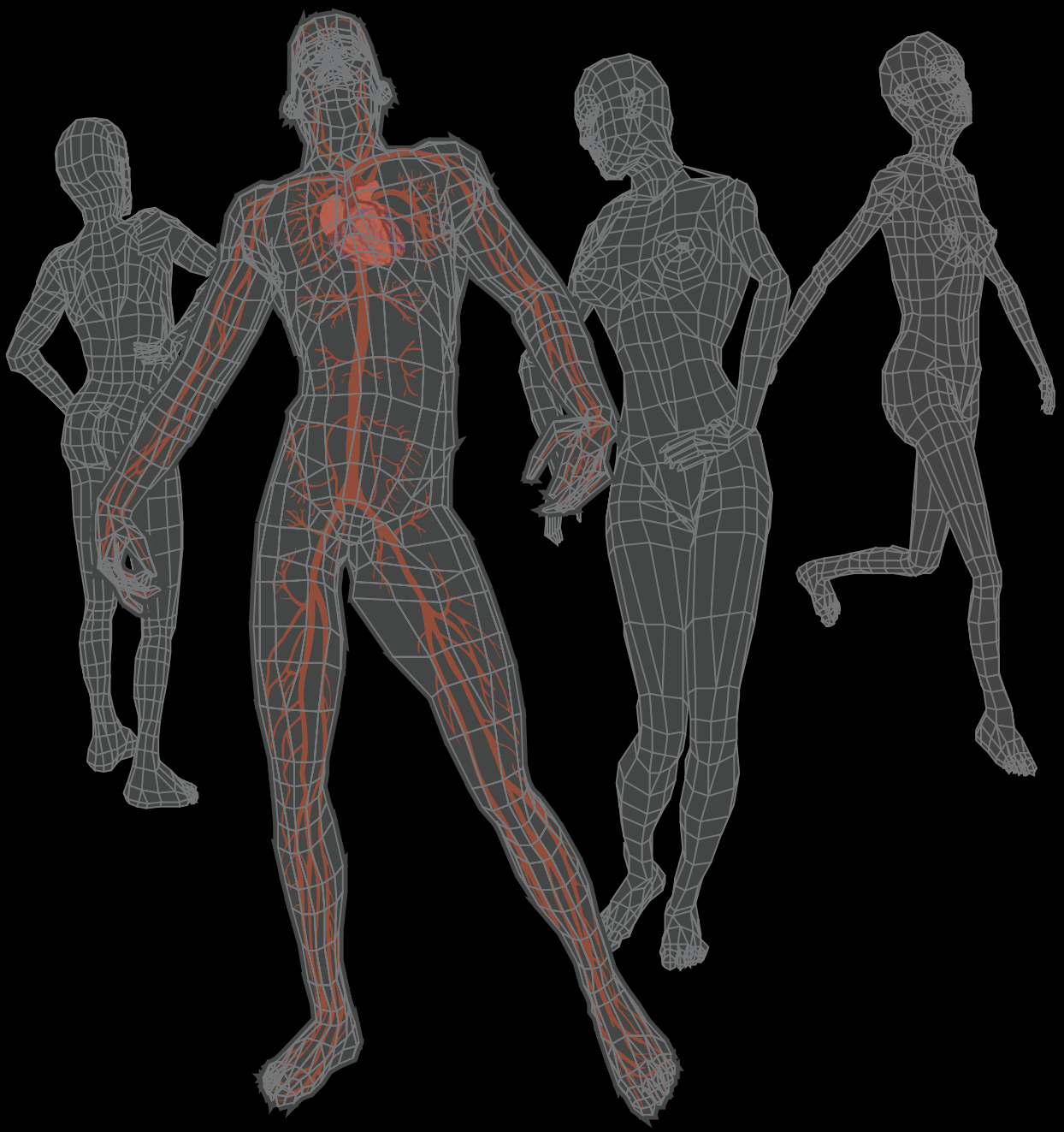
Lecturer in bacteriology at Newcastle University and Caulobacter expert Dr. Phillip Aldridge said this study is one of a very few that looks into how sticky sugars actually are.

"Look what happens to your fingers after eating a jam doughnut or dried spilled soft drinks. We also know that these type of interactions are the strongest interactions out there and they all in some way involve sugars."

He added: "The good thing about many polysaccharides like the Caulobacter holdfast is that not much eats them in this form (remember they are sugars, one thing all organisms need to grow)—they first must break them down.

"The hardest part about using it would be preventing it from sticking to things during production."





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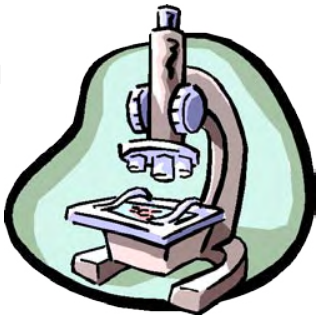
Greetings Continued From Page 1

Manufacturing, and the US Society of Biomaterials while others have been "closed door" presentations at large and small medical device companies that are seeking to improve their understanding of materials structure, and their evaluations of biomaterial and device interactions with living systems. In addition to tutorials on methods and instruments, a central thesis I have presented to these audiences is that Microscopy may be the single most important tool for medical device evaluation. In the following, I will provide you why I believe this is so:

First of all, it is difficult to even think of a single invasive or implantable medical device for which some form of microscopy was not used during its development. After all, the light microscope is the universal symbol of science and technology. To justify this statement I need look no further than to the clip art provided with the software I am using to draft this editorial: Under Science and Technology the lead clip art is exactly this:



And certainly, medical device development is based in both Science and Technology. But, lets consider what microscopy really is?

Microscopy is generally defined as any technique for producing visible images of structures too small to otherwise be seen by the human eye. This is only a marginally adequate definition, since microscopy is more than just making pictures of details that are smaller than ~0.1 mm (the approximate resolution limit of the human eye). Microscopes comprise a family of instruments that provide information on the spatial relationships of many different aspects of composition or structure. Besides imaging structure in the geometric relationship sense, different type of microscopes also provide chemical, mechanical, physical, molecular, biomolecular, cellular, and even temporal aspects of this information. The operative phrase beyond small, for what separates microscopy from other scientific instruments is spatial relationships. With medical applications, the universal value of microscopy becomes apparent since success of a material or device depends on interactions with living systems that operate at the scale of proteins, cells, fibrotic capsules, capillary networks, as well as other sub 0.1 mm structures. At this scale, biology is interacting with the roughness of surface finishes, the integrity of organic coatings, polymer microdomains, metal grains and phase boundaries, nanoscale small molecules and biomolecular drugs, and microparticulates generated from orthopaedic bearing wear. Thus, a medical devices' success or failure fundamentally occurs at microscopic dimensional scales. Not coincidently, these material characteristics are exactly what SurFacts readers deal with every day.

At this point, I doubt that I have informed the SurFacts readership of much that is not known to them, at least in general. But, why is this information so central to the science and the business of medical device development? The answer to this question is multifold but can be summarized by addressing the specific purposes microscopy is applied to in medical device development.

Clearly, microscopy is used for research and development, quality assurance and control, and regulatory approval documentation. However, it is also necessary to more broadly consider the business of medical devices.

Microscopy is as the primary tool used to "sell" your device: During development, you need to determine structure and function in order to sell your technology to yourself and your firm, and to provide critical information to understand and improve performance. You then need to present or sell this convincing data to your customers, the physicians who would use your device, the reimbursement and purchasing gatekeepers who may choose to buy it, and even to the patients themselves. If you are an early stage firm, you will also need images to sell your concept or idea to obtain the necessary funds for development and marketing (and in a large firm you will do this internally). That is, you need to sell to investors and potential corporate partners. Last, but certainly not least, you must prepare for the final and, woe be to you if needed, the post-final sales. The final sale is to convince regularity bodies and reimbursement gatekeepers that your device is safe and effective so that it can be approved and paid for. The post-final sales, which you hopefully may never need, is to have the data to sell your technology to judges, juries, and the press: If there is an "undesirable clinical event" can you demonstrate that your development and testing was performed at the highest level of state-of-the-art analyses? Poorly done microscopy-based analyses, or where there is an obvious conflict of interest in how the analyses were done, such as having all analyses performed by the internal development team, can sink a device in court, and thus greatly harm the company. The second post final sale, which also may never be needed, is to have the data to support the validity of your patent if this is threatened.

So microscopy is a sales tool. But whys does "selling" your technology require microscopy, more so than other analytical tools such as XPS or mechanical or corrosion or other data? Simply put, images are universally understood. We are "hard-wired" for image processing. In contrast, analyzing quantitative data is a learned skill. I am sure that most of you have tried to explain XPS or FTIR spectroscopic or similar data to your spouse, friends, family, or your attorney. Not easy, was it? Yet, show them a scanning electron microscope image and with even a minimal explanation, it will be understood. Physicians, regulatory reviewers, investors, judges, juries, the lay public, as well as scientists and engineers, all can interpret pictures. And this is exactly who you have to convince! (Of course, the proper type of microscopy and especially the proper preparation of the sample is a required prerequisite for the image to be useful for any purpose from R&D to litigation defense. Perhaps making this choice and doing things right should be a topic for a future editorial or article? Let me know if you would like this discussed..)

To summarize, microscopy of medical devices is without question a central instrument for R&D, Quality Control, regulatory submission and legal defense. No other family of instrumentation provides spatial relationship information and images that are so accessible for all concerned with the development of medical devices, their use, their approval, and potentially with any litigation that might come. Sell wisely.

Bay Area Medical Device Firms Snagging Millions from VCs

By Becky Bergman
Silicon Valley/San Jose Business Journal

As 78 million people begin to embrace their golden years, the medical device industry is poised to sell them everything from wrinkle cream to hip replacements. By some estimates, Baby Boomers present a $480 billion market opportunity for new products and services.

The boomers want to run faster, do more and live longer, says Tom Salemi, senior editor for *Venture Capital Analyst-Health Care*, a trade publication. They also form a generation with deep pockets.

As a result, VCs invested $548.4 million in 45 U.S. medical device companies in the first quarter of this year. That's up from the $468.2 million invested in the first quarter last year, according to a report by Dow Jones VentureOne and Ernst & Young.

Nationally, biopharmaceutical firms gobbled up $820.5 million during the first quarter of this year, pushing total U.S. health care investments to $1.62 billion.

While bioscience companies historically lead the bull market for venture capital funds in the health care sector, medical device firms in the Bay Area dominated the investment landscape during the first quarter this year, said Robert Browne, a VC advisory group leader with Ernst & Young in San Jose.

Investors poured $218 million into Bay Area medical device companies compared to the $162 million allocated to biopharmaceutical firms, according to Mr. Browne.

He predicts the medical device category could garner $900 million in investments this year, the highest in 5 years.

The U.S. spends $2 trillion a year—or 16 percent of its gross domestic product—on health care, a figure that is likely to increase to $4 trillion by 2015, according to the National Coalition for Health Care in Washington, D.C.

Diagnostic tools and medical devices account for 10 percent of that total, while non-invasive cosmetic surgery and skin care snagged $12.5 billion of the overall health market.

Health care companies that can deliver products through non-invasive methods are poised to do well, predicts Mr. Salemi.

"Anything that makes a medical professional's job easier or makes the consumer's life better is going to be a hit with investors," he says. "When a consumer has a choice between taking a drug for a lifelong medical condition and scheduling a one-time non-invasive procedure, they will choose the procedure."

Pleasanton-based Aesthera is a Kleiner Perkins Caufield & Byers investment that is developing a light-based medical device for the cosmetic marketplace. The company, which secured $11 million, develops a technology used for pain-free hair reduction and skin rejuvenation.

Mountain View-based Reliant Technologies recently banked $22 million in venture funding. As a developer and manufacturer for medical technology used in aesthetic applications, the company provides laser medicine and surgery used for wrinkles, pigmented lesions and photo-damaged skin for the face and body.

"Anything that requires software to drive the product is a good bet right now," says Mr. Browne, who adds that VCs with engineering backgrounds are more likely to understand the inner workings of a technology-based company versus a firm that manufactures drugs.

Medical device companies also appeal to venture capitalists because they face far fewer regulatory hurdles than drug companies do. It can take as many as 10 to 15 years for a biotech company to go through clinical trials, compared to three to five years for medical device firms.

"Medical device firms are less capital-intensive and the clinical trials are shorter," says Mr. Salemi. "Ten years ago, a company could get funded by showing it had plans for a promising product. Today, VCs are looking more closely at companies that have reached clinical trials and trying to reduce their risk by investing in mature products and mature companies."

Case in point: Redwood City-based Cardica Inc. designs and manufactures automated anastomotic systems used by surgeons to perform coronary artery bypass graft surgery (CABG). In CABG procedures, veins or arteries help construct bypass conduits to restore blood flow beyond closed or narrowed portions of coronary arteries.

The company raised $35 million in February during its initial public offering. Its stock opened at $10 per share in February; shares hovered around $8.12 during the last week of June. It was the only medical device IPO in the first quarter of 2006 and the first medical device IPO since 2004.

Analysts say biotech companies will continue to grab a large chunk of change from investors, but there are still many opportunities for medical device firms.

"Anything to do with cardiovascular health is big right now," says Mr. Browne. "Heart disease is a major concern and companies that can tap into that will get funding."

Meeting/Conference/Trade Show Calendar

Meeting/Conference/Trade Show	Place	Dates	Web Address
33rd Annual Meeting of the Controlled Release Society	Vienna, Austria	07/22/06 – 07/26/06	http://www.controlledrelease.org/meetings/index.cgi
Advances in Tissue Engineering 2006	Houston, TX	08/16/06 - 08/19/06	http://tissue.rice.edu/
Microscopy and Microanalysis	Chicago, IL	07/30/06 – 08/03/06	http://mm2006.microscopy.org/
14th Annual Short Course	Seattle, WA	08/23/06 - 08/25/06	http://www.nb.engr.washington.edu/home/workshop
UWEB 2006 Summer Symposium, " WHAT I: The 1st International Symposium on Wound Healing and Technology	Seattle, WA	08/28/06 – 08/30/06	http://www.uweb.engr.washington.edu/about/news.html#shortcourse
European Society of Cardiology (ESC) Congress	Barcelona, Spain	09/02/06 - 09/06/06	www.escardio.org
ICEM XVI International (International Congress on Electron Microscopy)	Sapporo, Japan	09/3/06 – 09/08/06	
American Society of Retina Specialists	Cannes, France	09/09/06 – 09/13/06	http://www.retinaspecialists.org/
Pediatric Interventional Cardiac Symposium (PICS)	Las Vegas, NV	09/10/06 - 09/13/06	http://www.picsymposium.com/2006/index.htm
2nd Marie Curie Cutting Edge Conference - Recent advances on polymeric based systems for controlled delivery of bioactive agent	Algarve, Portugal	10/02/06 - 10/06/06	http://www.biomat.net/biomatnet.asp?file=411
TERMIS-EU Annual Meeting	Rotterdam, The Netherlands	10/08/06 - 10/11/06	http://www.etes2006.org
BMES 2006 (Biomedical Engineering Society Annual Meeting)	Chicago, IL	10/11/06 - 10/14/06	http://www.bme.northwestern.edu/bmes2006/
Transcatheter Cardiovascular Therapeutics (TCT)	Washington, DC	10/22/06 – 10/27/06	www.tctmd.com
Medical Design & Manufacturing Minneapolis (MD & M Minneapolis)	Minneapolis, MN	10/25/06 – 10/26/06	http://www.devicelink.com/expo/minn05/
AVS 52nd International Symposium on Biomaterials Science	New Brunswick, NJ	10/30/06 – 11/04/06	http://www2.avs.org/symposium/boston/meetingsevent.html
8th New Jersey Symposium on Biomaterials Science	New Brunswick, NJ	11/08/06 – 11/10/06	http://www.njbiomaterials.org/web/index.php?p=news-events&s=7794 www.aao.org
American Association of Ophthalmology (AAO)	Las Vegas, NV	11/11/06 – 11/14/06	http://www.aao.org/
American Heart Association Scientific Sessions	Chicago, IL	11/12/06 - 11/15/06	http://scientificsessions.americanheart.org/portal/scientificsessions/ss/
American Vacuum Society (AVS)	San Francisco, CA	11/12/06 – 11/17/06	http://www.avs.org/
American Institute of Chemical Engineers (AIChE) Annual Meeting	San Francisco, CA	11/12/06 – 11/17/06	http://www.aiche.org/conferences/spring/index.htm
BioInterface 2006	**San Mateo, CA**	**12/4/06 – 12/6/06**	**www.surfaces.org**
Biomaterials from 2D to 3D to Larger than Life: A Symposium on the Future of Biomaterials to Celebrate Buddy Ratner's 60th Birthda	Maui, HI	12/14/06 – 12/17/06	http://www.uweb.engr.washington.edu/about/2dto3d.html
Medical Design & Manufacturing West (MD&M West)	Anaheim, CA	2/12/07 - 2/17/07	http://www.devicelink.com/expo/west06/

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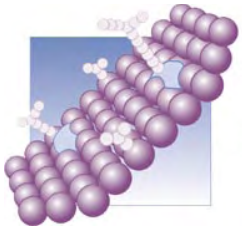

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