Keynote Address

There May Be a Smart Polymer in Your Biomaterials Future!
Allan S. Hoffman
Professor of Bioengineering
University of Washington

Professor Hoffman studied at M.I.T., where he received B.S., M.S., and Sc.D. degrees in Chemical Engineering between 1953 and 1957. He taught on the faculty of the Chemical Engineering Department at M.I.T. for a total of ten years and for the past 39 years he has been Professor of Bioengineering and Chemical Engineering at the University of Washington in Seattle, Washington, USA.

He was President of the Society For Biomaterials (US) in 1983-4, and received the Society's Clemson Award for Contributions to the Biomaterials Literature in 1984. He has also received the Founders' Awards from the Society for Biomaterials in 2000 and from the Controlled Release Society in 2007. He received the Biomaterials Science Prize of the Japanese Society for Biomaterials in 1990 and an International Recognition Award of the Society for Polymer Science, Japan in 2006. He was elected to the US National Academy of Engineering in 2005.

Symposium

A Symposium focuses 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. 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.

Applications of Nanomaterials in Medicine

Contributing SIGs: Dental/Craniofacial Biomaterials, Nano Materials, Ophthalmic Biomaterials, Orthopaedic Biomaterials
Invited Speaker: Katherine Ferrara, PhD
TITLE: Biomaterials for Image-Guided Drug Delivery
Co-Chairs: Sarit Bhaduri, PhD, Thomas Webster, PhD

This symposium will focus on all applications of nanomaterials in medicine. A comprehensive range of nano-materials will be considered including nano-particulates/fibers, nanocoatings, nanocomposites, NMES, etc. A comprehensive range of medical applications of such nanomaterials will also be considered (including tissue regeneration for the following tissues: orthopedic, cartilage, vascular, dental, nervous system, cardiovascular, etc.; drug delivery; ophthamological applications; cancer treatment; dermatological applications; etc.).

Biofilm-Material Interactions

Contributing SIGs: Implant Pathology, Proteins and Cells at Interfaces, Surface Characterization & Modification
Invited Speaker: James Bryers, PhD
TITLE: Emerging Biomaterials Strategies to Prevent Biofilm Infection
Co-Chairs: Nancy Lin, PhD, Howard Winet, PhD, Nicholas Ziats, PhD

As a biomaterial is implanted, a race for its surface ensues. If the surgery and implant are clean enough, the initial film formed is composed of small molecules followed by proteins, other large molecules and cells, led by monocytes/macrophages. If bacteria interrupt this process and establish a beachhead, they can form a film that seals them into an anaerobic culture chamber where they can produce a life-threatening infection. Since 80% of hospital acquired infections are associated with implants or indwelling devices, there is a great need to develop surfaces that resist biofilms yet incorporate optimally into the surrounding tissue. This symposium will explore these biofilms and strategies to prevent them. The invited speaker will set the tone by defining the problem and current research to find solutions for it. Speakers will report their new insights into understanding biofilms and new tactics to overcome them.

Cardiovascular Materials and Polyurethane Biomaterials

Contributing SIG: Cardiovascular Biomaterials
Invited Speaker: James Anderson, MD, PhD
TITLE: Cardiovascular Materials and Polyurethanes: Issues and Perspectives
Co-Chairs: Vipul Davé, PhD, Elazer Edelman, MD, PhD, Peter Edelman, PhD, Curtis Herbert, PhD

Increasingly, materials are tailored specifically to the cardiovascular domain. Many challenges in the use of conventional engineering polymers have been recognized. This session presents new developments in cardiovascular-specific materials for application in the next generation of cardiovascular implants. Advances in the very significant category of polyurethane materials are presented, including new formulations, improved coatings, and biodegradable polyurethane. New materials for directly reinforcing post-infarct damaged blood vessels are presented.

Cell Funtion in 2D vs 3D Culture

Contributing SIGs: Proteins and Cells at Interfaces, Tissue Engineering
Invited Speaker: Andrew Putnam, PhD
TITLE: Matrix Compliance and Cell Function: Understanding Differences Between 2D and 3D Cultures
Co-Chairs: Nathan Gallant, PhD, Carl Simon, PhD

Though cell culture on 2D flat substrates is comparatively easy, 3D scaffold systems for cell culture can more accurately represent in vivo conditions leading to more physiologically relevant cell behavior. This symposium will explore benefits of 3D culture systems and investigate how and why they differ from traditional 2D systems.

Multi-factor Drug Delivery for Musculoskeletal Regeneration

Contributing SIGs: Drug Delivery, Orthopaedic Biomaterials, Tissue Engineering
Co-Chairs: Yusuf Khan, PhD, Liisa Kuhn, PhD, Jan Stegemann, PhD

This session will focus on the delivery of multiple factors to enhance musculoskeletal regeneration, including the delivery of growth factors in combination with antibiotics. The multi-factor delivery approach can be used to enhance single tissue regeneration, or to achieve multiple tissue types within one scaffold. The session will cover biomaterials chemistry and design to achieve temporal and spatial control of multiple factor delivery, in vitro release and efficacy testing, as well as in vivo proof-of-concept testing.

Pluripotent Stem Cells in Regenerative Medicine

Contributing SIG: Biomaterials Cell/ Organ Therapies
Invited Speaker: Charles Murry, MD, PhD
TITLE: Repairing the Infarcted Heart with Engineered Human Myocardium
Co-Chairs: Todd McDevitt, PhD, William Murphy, PhD

Pluripotent stem cells, such as embryonic stem cells, are poised to become an integral component of regenerative medicine approaches. The ability of these cell types to continuously self-renew and differentiate into an array of different somatic cell types opens up new possibilities in fields ranging from in vitro drug screening to in vivo tissue engineering. Furthermore, the recent development of induced pluripotent stem (iPS) cells is likely to further expand the potential of stem cell research and therapy. However, pluripotent stem cells also present unique challenges to biomaterials scientists, as the fate of these cells can be strongly influenced, and perhaps controlled, by the physical and biochemical properties of their microenvironment. This symposium will describe new developments in pluripotent stem cell biology, with an emphasis on the key role of cell-biomaterial interactions in pluripotent stem cell culture and regenerative medicine.

Self-Assembly in Tissue Engineering

Contributing SIG: Tissue Engineering
Invited Speaker: Michael Sefton, ScD, FRSC
TITLE: In Vivo Assembly of Endothelialized Modules for Tissue Engineering
Co-Chairs: Donald Elbert, PhD, Jeffrey Karp, PhD, Ali Khademhosseini, PhD

Recreating the complexity of tissues and biomimetic architectures is one of the major aims of tissue engineering. One approach to do this is by using self- or directed assembly approaches. This session will cover bottom-up approaches that are utilized to create tissues to serve as in vitro tissue models and as potential therapeutic tissue engineered constructs. The session will cover areas such as modular tissue engineering, microengineered scaffolds as well as biomimetic tissue constructs. These approaches have emerged as suitable methods of recreating the complexity of tissue structures and enhancing the function of engineered tissues. This session will also include self-assembled gel/biomaterial based strategies for developing suitable scaffolds to grow and cultivate cells and strategies to promote self-assembly of cells within 3D. These materials may include self-assembled peptides, polysaccharides, lipids, nucleotides and viruses as tissue engineering materials.

Surface Modification and the Biological Response

Contributing SIG: Surface Characterization & Modification
Invited Speaker: Michael Grunze, PhD
TITLE: A new coating for medical implants: Polyzene®-F
Co-Chairs: Shrojal Desai, PhD, Jeff Schwartz, MD

When a device is implanted into the body, into either hard or soft tissue, the body will respond. While the bulk material of the device is often important for mechanical success, the device surface is at the interface with biology. Major effort has been spent modifying a biomaterial surface in order to elicit or inhibit a biological response. This session will focus on novel surface modification techniques that are added to the surface to control or induce a specific biological response. Talks will contain characterization of the modified surfaces that could include XPS (ESCA), AFM, SIMS, SEM, SPR, ATR-FTIR, or other surface analytical techniques. This general session is divided into two parts with the first opening talk provided by an invited speaker discussing a clinically relevant application of an available biomaterial from industry.

Stem Cell-Biomaterial Interactions

Contributing SIG: Tissue Engineering
Invited Speaker: Jeremy Mao, PhD
TITLE: Stem Cell and Polymeric Materials Interactions: Cell Delivery and Cell Homing
Co-Chairs: Treena Livingston Arinzeh, PhD, Jeremy Mao, PhD

Stem cells have become a promising cell source in the tissue engineering field. Major advances have occurred in the isolation and characterization of stem cells derived from embryos, nonembryonic/adult sources, and more recently, adult somatic cells that can be genetically reprogrammed to become pluripotent stem cells. Intense studies have been focused at the cell and molecular biology levels on understanding the relationship between stem cell growth and terminal differentiation in an effort to control these processes. Recent discoveries have shown that the microenvironment can influence stem cell self-renewal and differentiation, which has had a tremendous impact on identifying potential strategies for using these cells effectively in the body. This session will feature presentations that describe studies examining the influence of biomaterials on stem cell behavior with an emphasis on biomaterials design that impart appropriate cues to stem cells to affect their behavior.

Targeted Drug Delivery/Polymer Conjugates

Contributing SIG: Drug Delivery
Invited Speaker: Mark Grinstaff, PhD
TITLE: Expansile Nanoparticles: Synthesis, Characterization, and In Vivo Efficacy
Co-Chairs: Rebecca Bader, PhD, Bingyun Li, PhD

The efficacy of therapeutic compounds is often reduced by the limitations of conventional drug delivery systems. For example, non-specific targeting typically results in adverse side effects and drug wastage. More advanced drug delivery systems are being developed to passively and actively target specific tissues, particularly those that are cancerous or inflamed. This symposium will highlight both particulate carrier systems and soluble macromolecular carriers designed to prevent toxicity at non-target organs and optimize therapeutic effectiveness. Examples of targeted drug delivery systems include liposomes, micelles, nanoparticles, microspheres, lipoproteins, antibodies, dendrimers, and soluble synthetic polymers.

General Sessions

A General Session is a topic that is familiar to the general membership. Abstracts reflect the most current research in that field.

Adipose Tissue Engineering and Biomaterial-Guided Stem Cell Behavior
Contributing SIG: Tissue Engineering

Of interest is the manner in which cells react to biomaterial properties such as relative smoothness or roughness, surface charge, mechanical rigidity, 3-dimensionality, and other biomaterial-related properties, but of greater interest is whether or not these biomaterial properties can be engineered to control or guide cell behavior. This session will focus on utilizing materials properties to guide cell behavior, specifically embryonic and mesenchymal stem cell behavior, toward the repair or regeneration of musculoskeletal tissues and adipose tissue. As for adipose tissue, the use of adult mesenchimal stem cells (both adipose-, ASCs, and bone marrow-, BMSCs, derived) or of preadipocytes is preferred to the use of mature adipocytes, which have low expandability and poor ability for volume retention. This session aims to collect recent scientific contributions on this not yet completely explored but emergent field.

Advances in Ophthalmic Biomaterials Technology
Contributing SIG: Ophthalmic Biomaterials

The ophthalmic biomaterials arena is a rapidly growing field for advanced biomaterials research with wide-spread clinical applications. For the 2010 SFB meeting, we invite you to a renewed session toward next-generation ophthalmic care. The topics encompass novel biomaterials technology for functional replacements of ocular tissues; surface modification and protein adsorption of polymers used for refractive devices; vitreous replacement fluids; retinal tamponades; and glaucoma drainage devices. The general session will focus on the progress of biomaterial-tissue interaction in development of next-generation ophthalmic drugs and medical devices. E.g. Investigation of tissue interactions (ciliary muscles) with ocular biomaterials for restoring lens accommodation. The session will also accommodate advances in ocular tissue-engineering. This year's meeting will feature a list of renowned academic, industrial, regulatory, and clinical speakers to highlight the advancement in ophthalmic biomaterials research. Keynote addresses from experts in the clinical setting will allow means to bridge the gap between materials research and clinical success. The general session on ophthalmic biomaterials will be a unique opportunity for all researchers to share and renew collaborations in a rapidly growing field.

Applications of Nanomaterials in Medicine
Contributing SIGs: Dental/Craniofacial Biomaterials, Nano Materials, Ophthalmic Biomaterials, Orthopaedic Biomaterials

This general session will focus on all applications of nanomaterials in medicine. A comprehensive range of nano-materials will be considered including nano-particulates/fibers, nanocoatings, nanocomposites, NMES, etc. A comprehensive range of medical applications of such nanomaterials will also be considered (including tissue regeneration for the following tissues: orthopedic, cartilage, vascular, dental, nervous system, cardiovascular, etc.; drug delivery; ophthamological applications; cancer treatment; dermatological applications; etc.).

Biomaterial Technologies for Treating Segmental Bone Defects: Research Developments and Clinical Applications
Contributing SIG: Orthopaedic Biomaterials

Treating bone segmental defects remains a major clinical challenge in the field of orthopaedic surgery. A significant number of approaches utilizing synthetic bone grafts have been developed and proven to have applications in bone repair and regeneration. This session will focus on bone graft design and fabrication, bone graft osteocompatibility and vascularization strategies, such as factor loaded grafts and programmed cells, to develop clinically relevant grafts for effectively treating segmental bone defects. This session will also cover pre-clinical evaluation of synthetic bone grafts in suitable animal models, and their clinical applications.

Biomaterials as Stem Cell Niche
Contributing SIG: Biomaterials Cell/Organ Therapies

Recent studies have demonstrated the presence of stem cell niches in most major organ systems, and the ability of these cells to transdifferentiate towards other tissue lineages is being explored. Understanding biomaterial-stem cell interactions and biomaterial-triggered signaling pathways is critically important in developing cell culture systems and therapies for regenerative medicine. This session will present new and ongoing work in the development of biomaterial-based strategies to culture and maintain stem cells in an undifferentiated state as well as the development of new strategies to differentiate stem cells into specific lineages. Particular focus will be on maintenance and differentiation of stem cells on various biomaterial surfaces, 3D culture, and bioreactor-based cultures. Our interest is in novel materials to present biologically active species, new ways of controlling biomaterials to mediate stem cell function and phenotype, as well as fundamental biological understanding of stem cell niches and how they can be artificially controlled.

Biomaterials for Directed Stem Cell Differentiation
Contributing SIGs: Biomaterials Cell/Organ Therapies, Tissue Engineering

This session will focus on recent biomaterials research targeted at directing the differentiation of progenitor and stem cells towards specific tissue lineages. It will cover a range of approaches applied to pluripotent and multipotent stem cells.

Biomaterials for Soft Tissue Engineering
Contributing SIG: Tissue Engineering

This session will review current state of the art in the development and evaluation of scaffold materials for ligament, tendon, diaphragm, and pancreatic regeneration.

Biomimetic Materials for Tissue Engineering
Contributing SIG: Tissue Engineering

Recently, biomaterial scientists have added bioactivity to their design toolbox in the development of new materials for tissue engineering scaffolds. These advanced biomaterials add another dimension of guided interaction with the body by mimicking the native remodeling processes, e.g. biological recognition of adhesion sites, substrate-dictated differentiation, or cell-guided enzymatic degradation. This session will review current state of the art in the development of biomimetic scaffold materials and the fundamental studies that use these materials to identify key substrate characteristics that support desired cellular behavior in tissue engineering constructs (adhesion, migration, proliferation, differentiation).

Cancer Drug Delivery
Contributing SIGs: Drug Delivery, Nano Materials

This session will cover current efforts in the area of drug delivery including the development of targeted multifunctional delivery system in which the drug or imaging moieties are integrated. Sustained release formulations are discussed in which the drug is released over a period of time in a controlled manner. Types of drug delivery formulations include liposomes, drug loaded biodegradable microspheres, and drug polymer conjugates at nano or micro scale. In addition to mechanisms directly therapeutic against cancer cells, indirect methods such as anti-angiogenic therapies, as well as other metabolic disruption will be discussed. Also, therapeutic delivery in regard to palliative care will be addressed.

Cardiovascular Controlled Drug Release
Contributing SIGs: Cardiovascular Biomaterials, Drug Delivery

The presentations and posters in this session will discuss novel concepts for cardiovascular drug delivery. This will include drug delivery from various medical devices; Computational modeling of release kinetics and tissue uptake; Novel tools to characterize drug release; Release from bioresorbable coatings and from coatings on fully resorbable devices: Impact of metal surface chemistry on drug release kinetics.

Cellular Responses to Biomaterials and Cardiopathologies
Contributing SIG: Cardiovascular Biomaterials

Cardiovascular materials science has entered a new age. This session presents research focused on the evolving field of cardiovascular-specific materials. Increasingly, new materials can be designed that account for cellular phenotype and behavior at the implant site. The interplay of cells with materials' surface and mechanical properties are presented, along with new theories for vascular calcification and insights into the fate of biologics diffusing from cardiovascular implants into the vasculature.

Chemoselective Chemistry for Biomaterials

Implanted biomaterials of synthetic or biological origin (or a combination of the two) undergo complex interactions with the immune system. However, these interactions are incompletely understood and poorly controlled, making it difficult to engineer them to achieve desirable outcomes in clinical applications. This session highlights current efforts toward both a basic understanding of interactions of immune cells with biomaterials as well as the engineering of biomaterials capable of directing or influencing immunological processes. These efforts have wide-ranging implications in diverse fields such as tissue engineering, combination products, and therapeutic vaccines.

Controlled Release and Presentation Systems for Regulating Cell Behavior
Contributing SIGs: Drug Delivery, Tissue Engineering

Drugs, growth factors and cytokines, and genetic material can be extremely powerful agents for directing cell behavior to regenerate tissues or combat diseases. One-time presentation of these bioactive factors through bolus delivery or burst release from biomaterials, however, often does not elicit the desired cellular responses. Temporal control of the delivery of these factors may allow for optimal exposure to cells. This control may be achieved using biomaterials or novel substrates via a variety of mechanisms including diffusion, polymer degradation, and environmental stimuli-driven release. In additional, spatial regulation over delivery may also be beneficial to, for example, mimic soluble signal gradients present during development and healing processes. This session will encompass the development of new biomaterial systems that modulate the spatial and temporal delivery of soluble signals and the quantitative evaluation of their capacity to guide specific, desired cellular functions.

Dental Materials
Contributing SIG: Dental/Craniofacial Biomaterials

This session invites basic, applied, and clinical biomaterials research using approaches ranging from synthetic materials to biological mechanisms of therapy, and including materials/biological constructs and tissue structure-function analyses as biomimetic/design bases. Each of these approaches converge into the larger objective of restoring oral tissue structure and function. Specific interests include synthesis, characterization, processing and application of any organic and inorganic materials used or having potential for use intra-orally or extra-orally for the restoration, fixation, replacement, or regeneration of hard and soft tissues in and about the oral cavity and craniofacial region.

Emerging Frontiers in Design and Characterization of Bio-inspired Nanoscale Research & Materials
Contributing SIGs: Nano Materials, Proteins and Cells at Interfaces, Surface Characterization & Modification

This session focus is on design elements requiring nanoscale science and technology. The presentations will highlight advances in areas where design concepts were inspired by living systems and have led to new functional materials aiming at different end-use applications. Emphasis is on identifying challenges and opportunities in developing the next generation of bioinspired self-assembling, self-healing, self-evolving, and/or self-replicating materials as well as obtaining detailed understanding of biological events and their interfacing with the design and fabrication of new biomaterials. This involves groups: synthesizing biomaterials with the intent of obtaining a previously determined nanoscale biological structure, using biomimetic synthesis strategies to obtain nanoscale structures, and characterizing nanoscale structures at the biological interface to provide design inputs for a future biomaterial or to confirm the design intent of an existing material.

Engineered Disease Models for Basic Research and Drug Discovery
Contributing SIG: Tissue Engineering

Microenvironmental conditions play an important role in the development and therapy of many diseases and may not be accurately modeled with conventional 2-D cell culture. This session will focus on the design and utilization of biologically inspired model systems for the study of disease pathogenesis and drug screening. It will introduce biomaterials, tissue engineering, and fabrication approaches for the development of 3-D tissue models that have the potential to reduce the use of animals and overall R&D costs.

Engineering Immune Interactions with Biomaterials
Contributing SIGs: Biomaterials Cell/Organ Therapies, Proteins and Cells at Interfaces

Implanted biomaterials of synthetic or biological origin (or a combination of the two) undergo complex interactions with the immune system. However, these interactions are incompletely understood and poorly controlled, making it difficult to engineer them to achieve desirable outcomes in clinical applications. This session highlights current efforts toward both a basic understanding of interactions of immune cells with biomaterials as well as the engineering of biomaterials capable of directing or influencing immunological processes. These efforts have wide-ranging implications in diverse fields such as tissue engineering, combination products, and therapeutic vaccines.

Engineering Therapeutic Delivery for Biomaterial Scaffolds for Cell Therapy
Contributing SIG: Biomaterials Cell/Organ Therapies

This session will focus on the development of new materials or methods for the controlled delivery of macromolecular therapeutics, including proteins and nucleic acids, from scaffolds. Scaffold-mediated delivery has received increasing attention because of its capacity to improve cellular utilization of delivered therapies. For example, immobilization of therapeutics to the scaffold localizes therapeutic activity and elevates local concentration; in some cases, it can enhance biological activity by optimizing receptor-ligand interactions. Immobilization can also provide control over the rate of therapeutic delivery. As mimetics of the natural extracellular matrix, the scaffolds themselves provide additional physical and chemical cues that control the cellular microenvironment and cell behavior. Topics for this session include new chemistries/methods for degradation-controlled release, layer-by-layer fabrication and release, cell-mediated therapeutic release, and other triggered-release technologies. Intended application areas are broad and would include in vivo and ex vivo regenerative therapies as well as cell manipulation for other applications.

Glycosaminoglycan Biomaterials in Medicine
Contributing SIG: Tissue Engineering

Harnessing the polysaccharide biomacromolecules of the extracellular matrix has attracted many research groups and led to a large variety of clinical biomaterials. What can we expect in the future for chemically-modified GAGs? This session will include abstracts describing pre-clinical and clinical uses of derivatives of hyaluronic acid, chondroitin sulfate, heparin, chitosan, and other GAGs, including hard and soft materials, nanostructured or microfabricated materials, and novel chemistries.

Molecular Mechanisms Mediating Protein-Surface and Cell-Surface Interactions
Contributing SIG: Proteins and Cells at Interfaces

While it is well recognized that biological responses to implanted biomaterials (e.g., inflammatory responses, platelet adhesion, and thrombus formation) are governed by proteins that adsorb on the biomaterial surfaces, relatively little is understood regarding the actual molecular mechanisms that control these types of interactions. Without a molecular level understanding of the factors that mediate these processes, biomaterials design to control them is essentially relegated to trial-and–error methods. Unfortunately, given the great complexity of protein-surface and cell-surface interactions, the probability of finding optimal conditions by such approaches is negligibly small. Therefore, although very challenging, increased efforts need to be made to study and understand the molecular basis for protein-surface and cell-surface interactions so that this knowledge can be applied for device design for improved biological performance. The objectives of this session are to spotlight this important area of research and provide a venue to present and discuss current research efforts in this area.

Natural-based Polymeric Biomaterials and Composites
Contributing SIG: Orthopaedic Biomaterials

Natural-origin polymers and its composites offer excellent opportunities in the biomaterials field. This versatile class of materials includes biopolymers (polyhydroxy alkanoates, hyaluronic acid), polysaccharides (starch, chitin/chitosan, alginate) or proteins (collagen, fibrin, silk fibroin) enabling developing engineered systems with enhanced biological performance. The innovative use of its characteristics, taking advantage of the similar structure or composition with respect to biological tissues, enables designing high performance solutions for biocompatibility, biodegradability and bioactivity of biomaterials. Also the advanced areas of tissue engineering, drug delivery and smart/active/adaptative systems may benefit from the wealth of natural polymers existing in nature. Those high end applications require increasingly complex and demanding architectures and properties. However, the processing and the characterization of natural origin polymers often has specific requirements and limitations that may hinder its use. This session will be the forum of choice to present and discuss cutting edge research on biomaterials obtained from natural based polymers.

Novel Imaging Methods for Mapping Cell Phenotype
Contributing SIGs: Proteins and Cells at Interfaces, Surface Characterization & Modification

Controlling cell phenotype is a critical step in developing successful tissue and organ replacements. This is not easily accomplished due to the myriad of factors at several different length scales that influence cell response and subsequent tissue development. Therefore, novel imaging approaches that can quickly and effectively provide correlations between cell environment and response are required. This session will showcase novel in vitro and in vivo 2D and 3D imaging techniques and probes that provide spatial information about the effect of cell/material interaction and surrounding environment on cell phenotype.

Probing the Surface of Biology
Contributing SIG: Surface Characterization & Modification

As surface analytical tools become more sensitive, researchers are provided the ability to use these techniques to image or probe a biological surface. Surface analytical equipment used to characterize metals and plastics are now being used to probe biological materials that were previously sensitive to these analytical techniques. Methods for sample preparation (preserving structure), environmental chambers or improved data collection have lead to this improvement. This session will focus on the imaging of biological structures using spectroscopic or microscopic surface characterization techniques. Relevant research using Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), Electron Spectroscopy for Chemical Analysis (ESCA or XPS), Sum Frequency Generation (SFG) and other surface analytical techniques performed on biological proteins, cells, and even tissues will be presented in this session.

Stimuli-responsive Scaffolds for Tissue Engineering: New Developments
Contributing SIG: Tissue Engineering

Tremendous research has been done in recent times to use polymeric biomaterials to guide three dimensional tissue formation both in vitro and in vivo. While both biodegradable and non-biodegradable polymers have been used for these applications, the stimuli-responsive polymers in both categories may offer unique advantages to achieve appropriate cell attachment, growth, morphology, and biological function. This general session aims to present and discuss new developments in the approaches and materials that are responsive to environmental cues. This session will include abstracts dealing with in vitro cell behavior (morphology and function) on advanced materials that are responsive to the cellular microenvironment. The externally controllable experimental variables may include (but not limited to) temperature, pH, and/or cellular products.

Surface Modification and the Biological Response
Contributing SIG: Surface Characterization & Modification

When a device is implanted into the body, into either hard or soft tissue, the body will respond. While the bulk material of the device is often important for integrity and mechanical success, the device surface is at the interface with biology. Major effort has been spent modifying a biomaterial surface in order to elicit or inhibit a biological response. This session will focus on novel surface modification techniques that are added to the surface to control or induce a specific biological response. Talks will contain characterization of the modified surfaces that could include XPS (ESCA), AFM, SIMS, SEM, SPR, ATR-FTIR, or other surface analytical techniques.

Surface Modification of Three Dimensional Scaffolds for Tissue Engineering Applications
Contributing SIGs: Surface Characterization & Modification, Tissue Engineering

Traditional modification methods such as migratory additives, plasma treatment, and photo-grafting have been successfully developed for scaffolds where cell contact is expected primarily at the scaffold surface. However, as the tissue engineering research progresses into creating three dimensional scaffold materials where cellular in-growth into the scaffold will be deemed essential, new modification methods will be required to overcome the challenges encountered by the traditional methods (such as depth of penetration in case of photo-grafting) when modifying three dimensional scaffold materials. This general session aims to present and discuss new developments in such "surface modification" approaches related to grafting and patterning of small molecules, polymers, and/or ligands on a three dimensional scaffold. This session will include abstracts related to characterization methods to ascertain a successfully modified three dimensional scaffold and abstracts focusing on methods to overcome challenges encountered when modifying and/or characterizing three dimensional scaffold materials compared to two-dimensional cell culture.

Surface Optimization to Maximize Biosensor Performance
Contributing SIGs: Nano Materials, Surface Characterization & Modification

Surface modification is a necessary prerequisite to optimize performance of the latest generation of biosensors including nanoparticles, protein chips and gene chips. From simple 1" x 3" microarray glass slides with hundreds of spots to higher density microarray chips (e.g. AffyMetrix®) with over 10,000 spots per cm2, the surface chemistry needs to be engineered and optimized to facilitate automated oligonucleotide synthesis, provide stability to maximize signal to noise during hybridization and during signal read-out via automated fluorescence imaging. The immediate technology focus is molecular diagnostics but the methodologies to be discussed have relevance to any surface modification where retention of specific biomolecular activity is desired under a specific set of conditions. This session will bring together Seattle area researchers and will solicit contributions from various local centers of molecular biology research, national centers as well as international.

Rapid Fire Sessions

Rapid Fire Sessions are one-hour sessions with two half-hour blocks, comprised of five, five-minute presentations, and a five minute Q&A for each block.

- **Applications of Nanomaterials in Medicine**
- **Biomaterials for Bone Repair**
- **Biomimetic Materials for Tissue Engineering**
- **Delivery and Immune Responses**
- **Engineering Materials for Medical Use: The New, the Improved, and the Coated**
- **Modern Tools and Techniques for Biomaterial Synthesis**
- **Orthopaedic Biomaterials for Bone Repair and Regeneration**

Workshops

Workshops provide an in-depth educational experience on topics relating to biomaterials with a significant amount of time dedicated to discussion, and questions and answers.

Surface Characterization of Biomaterials
Contributing SIG: Surface Characterization & Modification

The National ESCA and Surface Analysis Center for Biomedical Problems (NESAC/Bio) will be running a workshop on "Surface Characterization of Biomaterials." An overview of the latest developments and advances in biomedical surface analysis will be given. The fundamentals and capabilities of ESCA and ToF-SIMS will be emphasized. Selected examples of recent surface analysis applications in the areas of biomedical nanparticles, molecular depth profiling of polymeric biomaterials, 2D/3D imaging of biological samples, and analysis of biological molecules at interfaces will be presented. Attendees will gain an appreciation for detailed characterization biomedical surface analysis methods can provide for a wide range of biomaterials.

Tour: Institute for Stem Cell Research and Regenerative Medicine (ISCRM) at the University of Washington
Contributing SIGs: Biomaterials Cell/Organ Therapies, Tissue Engineering

This tour of the new Institute for Stem Cell and Regenerative Medicine (ISCRM) at the University of Washington's South Lake Campus will allow participates to view the facilities and equipment used for stem cell research, and will have the opportunity to interact with ISCRM researchers and bring about possible research collaborations. Participants will be provided with a box lunch at the ISCRM. Following lunch, an overview presentation of ISCRM research areas and facilities will be given to the tour participants. Following the overview, participants will be given a choice of ISCRM laboratory tours (Cardiovascular Biology, Spinal Cord Regeneration, Retinal Regeneration, Ellison Stem Cell Core, Cardiovascular Imaging, and Quellos High Throughput Screening Core) to talk with the researchers, see experiments, view research poster presentations and better understand the science and the equipment used to pursue the research.

Panel Discussions

Panel discussions 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.

Advancing Biomaterials Education
Contributing SIG: Biomaterials Education

Session Chair: Cassandra Wright-Walker

This is a multi-faceted panel discussion to address topics of interest in biomaterials education both at the college level with new methodologies & techniques as well as changing the way biomaterials-related courses are taugh to produce better qualified graduates. Advantages and shortcomings of current graduates will be addressed. Additionally, K-12 outreach module development will be discussed. The focus on outreach is designed to address the issue of slowing the 'leaky pipeline' with respect to the loss of potential engineers.

After My Degree – Industry or Academia?
Contributing SIG: Biomaterials Education

Session Co-Chairs: Julie Liu, PhD, Margaret Phillips

This panel and networking luncheon will provide an opportunity for graduate students to explore different career options. Speakers from industry and academia will discuss their career paths and provide insight and advice. Each lunch table will include students and at least one SFB leader or member currently in academia or industry. After the presentations, there will be time for students to network and discuss their questions.

Grand Challenges for Biomaterials Science and Engineering Research and Education

Session Chair: William Reichert, PhD

In 2009 the National Academy of Engineering issued a list of fourteen Engineering Grand Challenges that must be addressed to achieve a sustainable, economiccaly robust, and politically stable future (http://www.engineeringchallenges.org/). The two NAE Engineering Grand Challenges most relevant to biomaterials are "Engineer Better Medicine" and "Engineer the Tools of Scientific Discovery." However, these alone do not come close to encompassing the spectrum of critical issues faced by modern biomaterials science and engineering. A panel of six esteemed members of the National Academy of Engineering, National Academy of Science, and the Institute of Medicine will present their thoughts on the scientific, engineering, clinical, regulatory, ethical and educational Grand Challenges facing the research, education and business communities that comprise the Society For Biomaterials. Topics include but are not limited to molecular mediation, drug delivery, organ restoration, tissue reconstruction, sensing, diagnostics, imaging, wound healing, prosthetics and cosmetics. It is hoped that a multi-component "Biomaterials Manifesto" will arise from this event.

Surgeons Panel: Overcoming Obstacles to Innovation
Contributing SIGs: Cardiovascular Biomaterials, Dental/Craniofacial Biomaterials, Ophthalmic Biomaterials, Orthopaedic Biomaterials

Session Chair: Lynne Jones, PhD

Successful innovation in the field of biomaterials requires careful planning and a knowledge of the processes involved and the obstacles to overcome. The

purpose of this program will be to give a brief overview of the experiences and challenges today regarding biomaterials and implants and where we think we will be tomorrow. The following topics will be addressed during this panel discussion: the process of innovation; intellectual property; academic/industry collaborations and associated conflicts of interest; off-label use of implants; the +/- of clinical trials; and obstacles specific to biologics. While many of the examples that will be used are related to orthopaedics, the experiences can be relevant to other medical disciplines.

Tutorials

Tutorials teach attendees about a specific technology or focus area. A tutorial 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.

Chemo-selective Chemistry

Session Co-Chairs: Joel Collier, PhD, Haeshin Lee, PhD

Increasingly, biomaterials are being synthesized from biomolecules and polymers that possess complex chemical reactivity, necessitating the use or development of highly chemoselective conjugation techniques. Recently developed approaches such as native chemical ligation, click chemistry, chemoselective surface modification, and engineered protein-protein interactions offer powerful routes for precisely constructing highly defined biomaterials from such complexly reactive biomolecules and polymers. This tutorial will provide an overview of recently developed chemoselective chemistries, along with practical guidance and tips for avoiding common pitfalls associated with them. The tutorial will be directed at two audiences: those wishing an overview of available chemoselective chemistries for synthesizing specific biomaterials of interest, and those currently employing chemoselective chemistries who may be seeking a forum for troubleshooting aspects of those evolving techniques. The tutorial will close with a short question-and-answer discussion session with the panel for this purpose.

Evaluation of Retrieved Implants

Contributing SIGs: Biomaterials Education, Implant Pathology

Session Chair: Howard Winet, PhD

How do we evaluate forensically whether an implant is biocompatible? Development of a biomaterials course with a lab section should be one goal of a comprehensive bioengineering curriculum. Not only would this be a useful introduction ot implant pathology, but it would provide practical experience in implant evaluation. In this tutorial an expert in retrieval pathology will present example cases. Each will be examined from three perspectives: 1) Biomaterial characterization, 2) Clinical experience, and 3) Host response to the implant. This will be followed by a discussion of future prospects for the field.

Wet Tutorial for Scaffold Fabrication

Contributing SIGs: Dental/Craniofacial Biomaterials, Proteins and Cells at Interfaces

Session Co-Chairs: Ali Khademhosseini, PhD, Carl Simon, PhD

Many intriguing strategies for fabricating 3D tissue scaffolds have been developed. Are you interested in learning these approaches? Would you like to learn how to electrospin nanofibers? How about directing assembly of microgels? This "wet tutorial" will provide practical information on six scaffold fabrication techniques with "wet" demonstrations by experts. Any level of scientist from beginner to advanced is welcome. The only requirement is a desire to learn new scaffold fabrication techniques.

Statistics in the Design of Experiments

Session Chair: Saida Khan, PhD

Knowledge of statistics is fundamental in designing and explaining the biological experiments. Every student and researcher should understand basic concepts of statistics and know how to use them in their experiments.

2010 Technology & Training Forums

These Forums will be technically-based educational opportunities hosted by SFB corporate supporters.

DSM Biomedical: "Biomaterials in a New Role: Treatment and Prevention of Infectious Diseases"

Biomaterials are commonly used to repair, replace or augment body parts damaged by disease, trauma and ageing. Cardiovascular, orthopedic, ophthalmic, and general surgical applications of high-performance biomedical polymers are well established, and are expanding rapidly. Increased understanding of how pathogens invade the body, and novel methods for modifying and characterizing polymer surfaces suggest *new* uses for biomaterials: *as selective adsorbents for bacteria, viruses and parasites in the treatment of disease.* Applications under development include extracorporeal affinity columns that 'clean' the blood and reinfuse it (after depleting it of pathogens), and small cartridges for 'purifying' banked blood during collection or transfusion. For example, properly designed adsorbent beds with covalently-bonded heparin can bind cytokines and many pathogens onto a modified polymer surface that is well known to be safe in bloodcontacting applications.

Agenda:

1. Recent trends and new biomaterials technology for repair, replacement and augmentation
2. Polymer surface modification and characterization
3. Synthetic polymers with bioactive surfaces
    1. Antimicrobial
    2. Selective binding
4. Heparin
    1. Systemic use as an anticoagulant
    2. Immobilized as a surface modifier for biomaterials
3. Binding capacity
    a. Clotting factors
    b. Pathogens and cytokines
5. Use of polymeric adsorbents in future clinical applications
    1. Prophylactic devices in blood banking and transfusion
    2. Extracorporeal therapeutic devices for the treatment of disease

Goals:
To review progress in the science and technology of high-performance biomaterials with optional bioactive surfaces, and to instruct device developers in the optimization of materials for new applications including the treatment and/or prevention of disease.

Who Should Attend?
Physicians, scientists, engineers and technicians involved in the design or manufacturing of medical devices who desire to learn more about state-of-the-art biomaterials and their optimization.

Veeco Instruments Inc.: "Atomic Force Microscopy: Characterizing Biocompatibility at the Nanoscale"

The events that occur in determining the biocompatibility of a biomaterial are all based on molecular-scale interactions. Understanding how the properties of a biomaterial can influence these interactions has important implications to ensuring successful development of medical devices and tissue scaffolds. Atomic force microscopy is an ideal technique for these molecular-scale measurements, as it can not only provide nanometer-resolution 3D topography images and quantitative measurements of surface roughness and nanomechanical properties but it can obtain these data *in situ* and in real time, under near-physiological time. This forum will educate attendees on the latest state of the art AFM technology for biomaterials characterization including a "hands-on" session on integrated AFM and optical microscopy.

Agenda:

- Introduction and overview of atomic force microscopy (AFM) technology.
- High-resolution, 3D imaging capabilities for materials and biological species (from single molecules to live cells and tissues).
- Quantitative measurements and 2D mapping of modulus, adhesion and molecular (un)binding events.
- Functional integration of AFM and optical microscopy for correlated high-resolution imaging and optically-guided nanomechanical property measurements.
- Hands-on session for integrated AFM and optical microscopy.

Goals:
The goal of this forum will be to provide all attendees with a solid foundation of AFM technology, available products, and real-life examples of biomaterials-related applications including, but not limited to, measurements of topography, roughness, adhesion, modulus, high-resolution imaging of single biomolecules and biomolecular complexes, live cell imaging and nanomanipulation. There will also be a hands-on session where attendees will have the opportunity to see how AFM and optical microscopy can be integrated to provide a powerful instrumental platform for biomaterials characterization.

Who Should Attend?
Academic and Industrial Researchers, Engineers and Applications Scientists are invited to attend this forum to learn how this powerful technology can help to improve the design, development and production of biomedical devices and tissue engineering scaffolds.

NSF and NIH Funding Opportunities in Biomaterials Science and Engineering

This information session will feature presentations by National Science Foundation and National Institutes of Health program managers describing funding opportunities available to biomaterials scientists and engineers. The session will be of interest to faculty, students and researchers seeking to identify funding for their research activities. The presentations will be followed by a question and answer period where you can have your government funding questions answered.