BIOMEDICAL TECHNOLOGY SHOWCASE

Friday, November 3, 2006
Bossone Research Center
Drexel University, Philadelphia, Pennsylvania

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School of Biomedical Engineering, Science & Health Systems
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Drexel University Main Campus

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Welcome to the Biomedical Technology Showcase (BTS)

Bringing Life Saving Solutions to Healthcare

On behalf of our students, faculty and the staff, it is my pleasure to host you at our inaugural Biomedical Technology Showcase.

The visit by the representatives of the Wallace H. Coulter Foundation exactly a year ago marked the formal launch of our Translational Research in Biomedical Technologies initiative in collaboration with units at Drexel and regional institutions.

We have organized the Biomedical Technology Showcase to provide a preview of our growing technology portfolio. We also wish to share our progress with our partners, stakeholders and plan for the next phase of our activities to rapidly move discoveries from our laboratories to clinical practice. Also, this event is an expression of our gratitude for the sincere endorsement and generous support we received from our foundation and corporate sponsors, economic development partners, our FDA colleagues, as well as our legal, investor and business development advisors.

Our Biomedical Technology showcase includes presentation and posters on biomedical technologies under development in Biosensors, Biomarkers, Bioimaging, Bioinformatics, Diagnostics (Ultrasound, Optics, Bionanotechnology), Drug Delivery, Neuroengineering, Tissue Engineering and Regenerative Medicine, and application areas including Pediatric Engineering and Skin Bioengineering. The panel on Translational Research in Biomedical Technologies will center on the opportunities and challenges of technology development in the academic setting.

I hope that you will have an opportunity to meet our students, faculty and staff behind the cutting edge biomedical technologies under development in our laboratories and will have a productive and enjoyable time on our campus.

Sincerely,
Banu Onaral, Ph.D.
H. H. Sun Professor and Director
Banu.Onaral@drexel.edu

Biomedical Technology Showcase 2006

Friday, November 3, 2006
Bossone Research Center – First Floor Lobby & Third Floor Atrium
(Bossone is located on Market Street, between 31st and 32nd Streets)

Agenda

9:30 a.m.  
Registration / Refreshments  
Bossone 3rd Floor Atrium

10:00 a.m.  
Welcoming Remarks  
Bossone 3rd Floor Atrium

10:30 a.m.  
Resources for Translational Research in Biomedical Technologies – Stakeholders Panel  
Bossone 3rd Floor Atrium

12:00 noon  
Lunch  
Bossone 3rd Floor Atrium

12:30 p.m.  
Biomedical Technology Poster Session  
Bossone 3rd Floor Atrium

Brain Trauma Technologies Showcase – Scenario Planning Meeting  
Bossone 304 – By invitation

1:30 p.m.  
Telling the Story of Your Biomedical Technology  
Organized by Baiada Center for Entrepreneurship in Technology  
Bossone 3rd Floor Atrium

3:00 p.m.  
Biomedical Resource Fair and Partners Expo & Reception  
Bossone 1st Floor Lobby

4:00 p.m.  
Seminar: "Translational Research: At the Intersection of Science and Business"  
Speaker: Rifat Pamukcu, M.D., President and CEO, Midway Pharmaceuticals Inc.  
Bossone Auditorium

Additional information and updates can be found at the BIOMED website: WWW.BIOMED.DREXEL.EDU/BTS
BIOMED RESOURCE FAIR
PARTICIPANTS

Internal
- The Laurence A. Baiada Center for Entrepreneurship
- Office of Research
- Steinbright Career Development Center
- Drexel University College of Medicine
- Lebow College of Business/ Executive MBA
- Drexel University Hagerty Library

External
- Science Center
- Ben Franklin Institute
- BioAdvance
- KIZ
- Pergamon
- Life Sciences Congress

Biomedical Technology Showcase (BTS)
Friday November 3, 2006
Bossone Research Enterprise Center - Third Floor Atrium

POSTER PRESENTATIONS COLOR CODES

BIOSENSORS & BIOMARKERS & BIOIMAGING & BIOINFORMATICS
DIAGNOSTICS & TESTING & THERAPEUTICS
ULTRASOUND, OPTICS, BIONANOTECHNOLOGY, DELIVERY of BIOACTIVE COMPOUNDS
TISSUE ENGINEERING & REGENERATIVE MEDICINE
NEUROENGINEERING
Biomedical Technology Showcase (BTS)

Friday November 3, 2006
Bossone Research Enterprise Center - Third Floor Atrium

RESEARCH ABSTRACTS – POSTER PRESENTATIONS

BIOSENSORS & BIOMARKERS & BIOIMAGING & BIOINFORMATICS


B2 Early Liver Cancer Detection Using a Novel Piezoelectric Biosensor (E. Ergezen, R. Weissbein, R. Lec, and A. Mehta)

B3 Effect of Processing Parameters on Contrast Agent Performance (D. Weiner and M. Wheatley)

B4 Analysis of the Outer Organic Phase in the Preparation of Polymeric Ultrasound Contrast Agents (J. Lewandowski and M.A. Wheatley)

B5 Nano-sized Ultrasound Contrast Agent: Feasibility Study (S. Kwon and M.A. Wheatley)

B7 A Blood Pressure Waveform Sensor for Rapid Characterization of Cardiovascular System (R. Lec, M. Swoboda, and M. Hochman)


B9 100 MHz sub-millimeter size fiber optic pressure sensors: A luxury or necessity? (S. Umchid, P.A. Lewin, and A.S. Daryoush)


B11 Real-Time Monitoring of the Effects of Heparan Sulfate Proteoglycan (HSPG) and Surface Charge on the Cell Adhesion Process using Thickness Shear Mode (TSM) Sensor (E. Ergezen, S. Hong, K. Barbee, and R. Lec)

B12 Real Time Analysis of Cell-Surface Adhesive Interactions using TSM Sensor (E. Ergezen, S. Hong, K. Barbee, and R. Lec)

B13 Combinatorial Biomarkers for Aging Research (A. Kriete, D. Boorman, K. Mayo, R. Jacob, and N. Yalamanchili)

B14 Targeting In Situ and Imaging Multiple Inflammatory Biomarkers with Quantum Dots in DSS Model of Colitis (A. Karwa, E. Papazoglou, K. Pourrezaei, S. Tyagi, and S. Murthy)


B16 Molecular Health Engineering: Virtual Reconstruction of Intracellular Biomolecular Dynamics in Clinical Samples (B.A. Sokhansanj and D.C. Lim)


B18 VEUSim: A Virtual Endoscopic / Endovaginal Ultrasound Simulator for Physician and Medical Student Training (T. Doehring, N. Handly, and C. Redmann)
DIAGNOSTICS & TESTING & THERAPEUTICS
ULTRASOUND, OPTICS, BIONANOTECHNOLOGY,
DELIVERY of BIOACTIVE COMPOUNDS

D1 Ultrasound Contrast Agent Targeted to Malignancies: Enhancing Surface Capacity for Peptide Conjugation (K. Oum, H. Newman, and M. Wheatley)


D4 Non-Heavy Metal Quantum Dots for Biomedical Application (H. Li, W.Y. Shih, and W.H. Shih)

D5 Detection of Heart Transplant Rejection Using Raman Spectroscopy (Y. Chung, C. Chang, D. Cao, S. Rassadi, and H. Eisen)

D6 Microencapsulated Doxorubicin in PLGA for Use in Ultrasound Triggered Drug Delivery (J. Eisenbrey and M.A. Wheatley)

D7 Drug-loaded Contrast Agents for Cancer Diagnosis: A Combination of Imaging and Therapy (O. Mualem Burstein and M.A. Wheatley)


D10 An Introduction to Bionanotechnology: An Interdisciplinary Educational Program (A. Parthasarathy, E. Papazoglou, K. Barbee, and P. Lelkes)


D12 Development of a Flow Cytometry Based Assay for Defective T-Cell Signal Transduction in the Rotating Wall Vessel Bioreactor (D. Simons and P. Lelkes)

D13 Handheld Tumor Scanner for Breast Cancer Detection (Z. Zhao, J. Zhang, J. Du, S. Nioka, and B. Chance)

D14 Development of a Smart & Novel Chimeric Antibody Drug Antagonist to Epidermal Growth Factor for Improved Cancer Therapy (V. Kamat, S. Cocklin, I. Chaiken, U. Rodeck, and E. Papazoglou)

D15 Use of Non-Thermal Atmospheric Pressure Plasma Discharge for Coagulation and Sterilization of Surface Wounds (G. Fridman, A. Fridman, A. Gutsol, V. Vasilets, G. Friedman, L. Peddinghaus, M. Balasubramanian, and A. Brooks)

D16 Preparation of Nanosomes for Trans-Dermal Delivery of Vitamin C for Reversing Skin Damage (N. Kulkarni, B. Khalique, E. Papazoglou and N.S. Babu)

D17 Mathematical Model Based On Queuing Theory to Predict the Controlled Diffusion In Alginate / PEG Hydrogels (S. Gadkari, L. Stephansky, E. Papazoglou, and N.S. Babu)

D18 Loading Carbon Nanotubes with Viscous Fluids and Nanoparticles – A Simpler Approach (E. Papazoglou, P. Katsikis, and N.S. Babu)
Tissue Engineering & Regenerative Medicine

T1 Effects of Encapsulated BDNF-Producing Fibroblasts on Dorsal Root Ganglia Neurite Growth (N. Francis and M.A. Wheatley)

T2 Development of an Implantable Alginate Scaffold for the Treatment of Spinal Cord Trauma (M. Shanbhag and M.A. Wheatley)

T3 Tissue Engineering Technologies for Cardiac and Neuronal Applications: Intelligent Scaffolds Made by Electrospinning, Lyophilization, and Critical Point Drying (M. Li, A. Perets, and P. Lelkes)

T4 Porogen-Based Solid Freeform Fabrication of Smart "Tools" for Orthopedic Surgery, Tissue Engineering and Regenerative Medicine (J. Zhou, L. Lu, F. Kleinbart, N. Johanson, and P. Lelkes)

T5 Alimentary Protein-Based Scaffolds for Personalized Tissue Engineering and Regenerative Medicine (A. Katsir, D. Woerdeman, L. Lin, M. Weingarten, and P. Lelkes)

T6 Dynamic Hi-Resolution Horizontal Microscope for Monitoring and Manipulating Real-Time Tissue Assembly (G. Botta, P. Manley, and P. Lelkes)

T7 Engineered Tissue Models for Drug Development: The Lung as a Paradigm (M. Mondrinos, S. Koutzaki, C. Finck, and P. Lelkes)

Neuroengineering

N1 Effects of Shear Stress Injury on the Morphology and Structure of Cultured Chick Forebrain Neurons (K. Barbee, D. Kilinc, and G. Gallo)

N2 Nanostructured Porous Silicon Scaffolds and Augmented Surface Coatings for Enhanced Biocompatibility of Multichannel Microelectrodes (S.J. Hallman, K. Barbee, and K.A. Moxon)

N3 Multi-site Analysis of Dopamine Uptake in the Somatosensory Cortex (A. Khair, C. Randall, and K. Moxon)

N4 Brain Computer Interface using Functional Near Infrared (fNIR) Spectroscopy (H. Ayaz, T. Heiman-Patterson, M. Schultheis, M. Izzetoglu, and B. Onaral)

N5 ACOBI: A Tool for Registering fNIR Data to Brain Surface Image (H. Ayaz, S. Platek, S. Bunce, K. Izzetoglu, B. Onaral, and K. Pourrezaei)

N6 Maze Suite: A Complete Set of Tools To Prepare, Present and Analyze Navigational & Spatial Cognitive Neuroscience Experiments (H. Ayaz, S. Levin, S. Platek, and Banu Onaral)

N7 FNIR for the Assessment of Cognitive Impairments Following Traumatic Brain Injury (M. Schultheis, M. Izzetoglu, and A.C. Merzagora)

N8 Portable Near-Infrared Technology for Detection of Traumatic Brain Injuries in Operational Environments (B. Ben Dor, B. Onaral, and B. Chance)

B1 Portable, Rapid, Label-Free, and Ultra-sensitive Array Pathogen Detection Using Piezoelectric Microcantilever Sensors (PEMS)

Authors: W.Y. Shih¹, J.P. McGovern¹, J. Capobianco¹, Q. Zhu¹, and W.H. Shih¹
¹Drexel University, Department of Materials Science and Engineering, Philadelphia, PA

Abstract: We have developed array lead magnesium niobate-lead titanate/tin (PMN-PT/tin) piezoelectric microcantilever sensors (PEMS) and lead zirconate titanate/SiO₂ (PZT/SiO₂) PEMS that offer the advantages of simultaneous, array, rapid, in-situ, label-free detection of multiple antigens in an aqueous environment. With array PMN-PT/tin PEMS 300 µm in length, we have demonstrated in in-situ, simultaneous, array detection of Salmonella t., E coli, and Bacillus globigii spores in the presence of as few as 10 cells or spores in less than 10 min in a volume ranging 100 µl-1ml. The PZT/SiO₂ PEMS less than 60 µm in length offers better than 10⁻¹⁶ g/Hz sensitivity, which is smaller than the mass of a single virus, 10⁻¹⁵g.

B2 Early Liver Cancer Detection Using a Novel Piezoelectric Biosensor

Authors: E. Ergezen¹, R. Weisbein¹, R. Lec¹, and A. Mehta²
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Drexel Institute for Biotechnology and Virology Research, Philadelphia, PA

Abstract: Two billion people have been infected with Hepatitis B virus worldwide and over 400 million people are chronically infected. Those with chronic Hepatitis B Virus (HBV) infections usually die from liver cancer but can be treated effectively if therapy starts early enough. Currently, the only reliable method is a direct biopsy, which is invasive, expensive, and is rarely applied. With the goal of creating a simple point-of-care device to more easily diagnose and monitor treatment, a biomarker was discovered and utilized to create a biosensor to detect liver cancer. This biosensor requires only a drop of human blood, is rapid, inexpensive, and portable.

B3 Effect of Processing Parameters on Contrast Agent Performance

Authors: D. Weiner¹ and M. Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract: Sonication is a crucial step in the manufacture of microencapsulated bubbles used as contrast agents (CA) for diagnostic ultrasound imaging. Hollow, poly (D,L-lactic-acid) microcapsules are prepared by a double emulsion (W(O)/W) method developed in our laboratory, and the power setting used to create the double emulsion has a direct effect on the morphology and size of the CA that is produced. This experiment is designed to find the optimal power setting (in watts) of the sonicator for the manufacture of uniform sized, highly echogenic microencapsulated bubbles.

B4 Analysis of the Outer Organic Phase in the Preparation of Polymeric Ultrasound Contrast Agents

Authors: J. Lewandowski¹ and M. Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract: Polymer shelled ultrasound contrast agents (CA) have advantages: stability: mechanical strength; ability to control the shell elasticity by choice of polymer, potential for targeted imaging and/or drug delivery. We have fabricated a polymeric CA by improvements to our current double emulsion-solvent evaporation procedure. By adjusting the volume of the outer organic phase in the emulsion step, the structure of the microcapsule could be controlled. With increasing volume the size became more uniform and the resulting shell more intact. Significantly, acoustic enhancement increased to a maximum of 25 dB
We showed that the outer organic phase is critical in the development of the structure of the CA shell and the acoustic characteristics of the microcapsule.

**B5 Nano-sized Ultrasound Contrast Agent: Feasibility Study**

**Authors:**
S. Kwon¹ and M. Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

**Abstract:**
Poly (D,L-lactic acid) is being investigated as a platform material for generating 200 nm sized ultrasound contrast agents. To overcome the weak echogenicity encountered with these particles, gas-filled nanoparticles have been designed. Sublimable porogens such as camphor were added to render the nanoparticles hollow and enable efficient gas introduction. Sulfur hexafluoride gas (SF₆), a hydrophobic and dense bio-inert gas, was introduced to enhance backscattered signals. Factors that may affect the physical and acoustic properties of particles were considered to optimize a gas-filled nanoparticles preparation method. We believe this study presents pioneering work to develop ultrasound imaging using nanobiotechnology.

**B6 A Blood Pressure Waveform Sensor for Rapid Characterization of Cardiovascular System**

**Authors:**
R. Lec¹, M. Swoboda¹, and M. Hochman¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

**Abstract:**
More than 60 million Americans suffer from cardiovascular diseases. We focused on two important complications: Aneurysm and Renal Artery Stenosis. We developed a device based on piezoelectric sensor that captures the blood pressure waveform and is capable of early detection of those diseases. This device is simple, safe, inexpensive and can be combined with standard ambulatory blood pressure tests. The detection, performed by Fourier and Wavelet analysis, helps to characterize arterial blood pressure waveform and detect pathologies. In the future this device may also allow improvement of titration of cardiovascular medications and patient outcome while reducing end-organ complication.

**B8 A Permanently Implantable Intracranial Pressure (ICP) Monitor**

**Authors:**
U. Kawoos¹, R.V. Warty², M.R. Tofighi³, F.A. Kralick⁴, S. Goldwasser², and A. Rosen¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Electrical and Computer Engineering, Philadelphia, PA
³Penn State University, the Capital College, PA
⁴Department of Neurosurgery, Hahnemann University Hospital, PA

**Abstract:**
ICP monitoring is invasive, short term and confined to hospitals. A reliable and mass-producible MEMS-based capacitive microwave ICP sensor and a portable monitor allowing long-term non-invasive ICP monitoring is being developed. The design has a LC tank oscillator operating at the ISM band of 2.4000-2.4835 GHz for -25to200 torr, with 0.37 MHz/torr sensitivity. Prototypes developed with a piezoresistive pressure sensor to monitor the signal transmission (range 0.8 meters), biocompatibility and integrity were implanted in animals. Subsequent animal tests will be carried out for one week to observe the device function and compare with the gold standard “Camino pressure monitor”. This project is funded by NIH, project number 1 R21 NS50590-01.

**B9 100 MHz Sub-millimeter Size Fiber Optic Pressure Sensors: A Luxury or Necessity?**

**Authors:**
S. Umchid¹, P.A. Lewin¹, and A.S. Daryoush²
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Electrical and Computer Engineering, Philadelphia, PA
Abstract:
In the past decade, medical diagnostic ultrasound has become the primary noninvasive imaging modality because unlike CT or PET-scanners it does not use the ionizing radiation. In addition it is inexpensive in comparison with the MRI imaging and last but not least ultrasound imaging provides real-time information on the moving anatomical structures. Although diagnostic ultrasound safety record is impeccable and no side effects were reported in clinical applications, in general, the ultrasound exposure may lead to undesirable biological effects. Therefore, the acoustic output of the diagnostic ultrasound devices is regulated and cannot exceed prescribed limits. In the USA, these limits are established by the Food and Drug Administration’s Center for Devices and Radiological Health, which requires the safety indicators such as Mechanical Index (MI) and Thermal Index (TI) to be displayed on the ultrasound imaging systems. Determination of these two indices requires precise characterization and measurements of the acoustic pressure-time waveforms produced by the imaging transducer. The objective of the research described here is to develop and optimize the calibration techniques for ultrasonic hydrophone probes capable of measuring acoustic fields at the frequencies beyond 20 MHz in particular beyond 60 MHz. Such techniques are currently unavailable and these high megahertz frequencies are gaining attention in skin, eye and intraluminal imaging as they offer enhanced sub-millimeter resolution. These objectives will be accomplished by development and implementation of two independent (acoustic and optic) measurement techniques that are capable of providing sensitivity versus frequency response of miniature ultrasonic probes over a wide, 100 MHz bandwidth. The innovative elements of the proposed research include implementing a 100 MHz fiber optic (FO) hydrophone probe with an active diameter of about 11 μm (microns) that will eliminate the need for spatial averaging correction and is sufficiently robust to measure fields generated by High Intensity Focused Ultrasound (HIFU) transducers. The intrinsically rugged characteristics of the fiber constitute an attractive feature as the existing probes are fragile and, in practice, cannot be used in therapeutic HIFU fields.

Abstract:
Thickness shear mode (TSM) has been used to analyze platelet adhesion and aggregation process which is an initial and vital event in the development of thrombosis. TSM sensor was operated at not only its fundamental frequency (5 MHz) but also at 15, 25, and 35 MHz. The changes in the resonant frequency and attenuation were monitored during the platelet adhesion on TSM sensor. Platelet rich plasma (PRP) from a healthy pig was used in the experiments. The surface of the TSM sensor was coated with the collagen which plays an important role in the activation of the platelets upon vascular injury. Various soluble inhibitors were mixed with the PRP to identify the ability of TSM technique to detect different level of adhesion and aggregation of platelets. Preliminary experiments were done to demonstrate the effect of α1β3 (GPIIb/IIa) antagonist abxicimab (ReoPro) on platelet adhesion. To explore the effectiveness of the sensor for characterization of collagen binding inhibition, the collagen binding inhibitors against to as α2β1 and GPVI were added to the PRP. These experiments indicated that the nano-acoustic shear wave sensor can be used as a novel, inexpensive and reliable tool to monitor the platelet-protein, platelet-platelet interactions and can be implemented for the clinical applications.
**B11 Real-Time Monitoring of the Effects of Heparan Sulfate Proteoglycan (HSPG) and Surface Charge on the Cell Adhesion Process using Thickness Shear Mode (TSM) Sensor**

**Authors:**  
E. Ergezen¹, S. Hong¹, K. A. Barbee¹, and R. Lec¹  
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

**Abstract:**  
A thickness shear mode (TSM) sensor was used to study the effects of Heparan Sulfate Proteoglycan (HSPG) and surface charge on the cellular interactions of the cell membrane with different substrates to determine the kinetics of cell adhesion. The TSM sensor was operated at 1¹, 3², 5³, and 7⁴ harmonics. Since the penetration depth of the shear wave decreases with an increase in frequency, the multi-resonance operation of the TSM sensor was used to monitor the changes in the kinetics of the cell-substrate interaction at different distances from the sensor surface. During the sedimentation and the initial attachment of the cells on the sensor surface, the changes in the sensor resonant frequency and the magnitude response were monitored. First, HSPGs were digested with the enzyme Heparinase III to evaluate the effect of HSPG on the cell adhesion process. The results indicated that HSPG did not have any effect on the kinetics of the initial attachment, although it did reduce the strength of steady-state adhesion. Next we investigated the effect of the electrostatic interactions of the cell membrane with the substrate on the cell adhesion. In this case, the sensor surface was coated with positively charged Poly-D-Lysine (PDL). It was observed that electrostatic interaction of the negatively charged cell membrane with the PDL surface promoted the initial cell adhesion but did not support long-term cell adhesion. The multi-resonant TSM technique was shown to be a very promising method for monitoring specific interfacial effects involving in cell adhesion process in real-time.

**B12 Real-Time Analysis of Cell-Surface Adhesive Interactions using TSM Sensor**

**Authors:**  
E. Ergezen¹, S. Hong¹, K. A. Barbee¹, and R. Lec¹  
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

**Abstract:**  
Cell adhesion process and the molecular interactions that determine its kinetics were investigated using Thickness Shear Mode (TSM) sensor. The goal of this study was to correlate sensor readings with the progression of cell adhesion. In particular, the specific effects of receptor-mediated adhesion, the glycocalyx, and surface charge on initial cell-surface attachment and steady state adhesion of endothelial cells were investigated. We found a strong correlation between magnitude changes (ΔMag) and the development of cell adhesion strength by comparing the sensor readings with independently assessed cell adhesion. The result showed that integrin binding determines the kinetics of initial cell attachment while heparan sulfate proteoglycan (HSPG) modulates steady state adhesion strength. Coating the sensor surface with the positively charged poly-D-lysine (PDL) enhanced the initial interaction with substratum.

**B13 Combinatorial Biomarkers for Aging Research**

**Authors:**  
A. Kriete¹,², D. Boorman¹, K. Mayo², R. Jacob¹, and N. Yalamanchili¹,²  
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA  
²Coriell Institute for Medical Research, Camden, NJ

**Abstract:**  
The biology of aging has been recognized as our biggest risk factor in developing a range of chronic and costly diseases like cancer, diabetes or Alzheimer’s. An increasingly aging population demands investigation of mid-life decline and development of individualized treatment strategies. Key in this view is to identify biomarkers reflecting biological age. Previous attempts to find such biomarkers have failed; one reason might be that chronological age as a primary classification parameter does not well reflect biological age. Further, most bioinformatics search strategies are tuned towards identification of the most up- or down regulated genes in age groups, without consideratio
of individual responses. Inspired by a systems biology view, we have developed a novel method to define correlative biomarkers across scales. Hereby we use a bioimaging based hyperquantification of cells and tissues to enrich the data mining process of related gene expression profiles. Dissection of data heterogeneity and consideration of individual responses is likely relevant to identify early onset markers of age related diseases.

B14 Targeting In Situ and Imaging Multiple Inflammatory Biomarkers with Quantum Dots in DSS Model of Colitis

Authors:
A. Karwa, E. Papazoglou, K. Pourrezaei, S. Tyagi, and S. Murthy

Abstract:
Inflammatory Bowel Disease affects nearly 1.5 million people. Currently, there are no efficient and reliable methods to quantify the degree of inflammation in these patients. The objective here was to image and quantify in an experimental model of colitis, MPO, IL1α and TNFα (proinflammatory cytokines) using Quantum Dots (QDs) conjugated with specific antibodies. The resulting fluorescence intensity was then used as a measure of concentration of MPO and in turn inflammation. The fluorescent images obtained from animals showed sequential increase in fluorescence intensity of MPO correlating (R = 0.96) with clinical disease. Fluorescent images also showed co-localization of all the three markers in both acute as well as chronic inflammation. These observations suggest that QD bioconjugates can be used nanotools to image biomarkers of inflammation.

B15 Improving the Efficacy of Cellular Therapy by Magnetic Cell Targeting

Authors:
Z. Forbes, K. Barbee, F. Stoddard, A. Brooks, D. Morgan, B. Yellen, and G. Friedman

Abstract:
The hot topic of stem cell research has raised hopes for new treatments for a breadth of ailments. As the expectations continue to mount, most related engineering research has been focused around new tools for isolation and propagation of cell lines, with inadequate attention to effective delivery strategies. Invasive or systemic injections come with increased risk and poor efficiency, often wasting a vast majority of the total cellular dosage. We present a method for magnetic targeting of cells in the body with the use of a two-source method of magnetic drug delivery proposed previously in the literature.

B16 Molecular Health Engineering: Virtual Reconstruction of Intracellular Biomolecular Dynamics in Clinical Samples

Authors:
B.A. Sokhansanj and D.C. Lim

Abstract:
Clinical Problem: Chronic diseases i.e. diabetes, COPD, caused by chronic inflammation, fundamentally alters the health of a cell at the molecular and cellular level. This reduced capacity is seen especially when exposed to acute inflammation from infections and trauma.
"cell health" of people be "imaged" for diagnostic and therapeutic development? Engineering Challenge: Accurately and comprehensively visualize the dynamics of proteins and cells? Interdisciplinary Solution: Measure key components of "cell health", associated with cellular energetics, damage, apoptosis, necrosis in samples from patients. Data obtained exposing cells to in vitro perturbations are applied to estimate a dynamic "cell health" model that can be used as a "virtual" system to analyze and predict cellular changes in response to acute stress.

**B17 Development of a Permanently Implantable Cardiac-Pressure Sensor**

Authors:
A. Parthasarathy¹, A. Rosen¹, P. Walinsky², P. Kurnik³, and S. Kutalek³

¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Thomas Jefferson University Department of Cardiology, College of Medicine, Philadelphia, PA
³Drexel University, Department of Cardiology, CoM, Philadelphia, PA

Abstract:
Congestive Heart Failure (CHF) is one of the high-risk ailments having over 5 million patients in the US with an annual expenditure of $40 billions in CHF treatments. Cardiac failures are often associated with the hemodynamic status of the heart; this could accurately be determined by developing a permanently implanted cardiac-pressure sensor facilitating long term and reliable measurement. The use of MEMS fabrication for device development and implementation of wireless technology gives an attractive package as a solution for the CHF patients.

**B18 VEUSim: A Virtual Endoscopic / Endovaginal Ultrasound Simulator for Physician and Medical Student Training**

Authors:
T. Doehring¹, N. Handly², and C. Redmann³

¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Division of Emergency Medicine, CoM, Philadelphia, PA
³Drexel University, Digital Media, CoMAD, Philadelphia, PA

Abstract:
3D Reconstruction: One of the most important aspects of accurate / fast visualization for realistic modeling is the need for optimized meshes of the highly complex pelvic anatomy. Above is shown four major steps of this process that we have developed for the VEUSim prototype. First, the rough mesh (A) which was obtained directly from MRI scan is converted to a voxel image (B), then the local thickness (C) is computed, and finally a volumetric energy minimization algorithm is used to compute an optimal surface mesh. Polygons are reduced by 60% and the model is ‘smoother’ for more accurate haptic feedback, improved simulation speed, and more realistic “feel”.

D1 Ultrasound Contrast Agent Targeted to Malignancies: Enhancing Surface Capacity for Peptide Conjugation

Authors:
K. Oum, H. Newman, and M. Wheatley

1Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
The objective of this study is to evaluate the influence of Polyethylene Maleic anhydride (PEMA) enhanced Arg-Gly-Asp (RGD) peptide modified Polylactic acid (PLA) microspheres, on extent of attachment to human breast cancer cells. Surface modification promotes CA targeting which is ideal for diagnostic imaging. In this study we examine v_3 targeted microbubbles created with PEMA:PVA ratios. After performing static cell attachment studies it was determined that a 50:50 ratio gave an optimal attachment of 3.75 microbubbles/cell. These results indicate that the amount of RGD conjugated to the surface of the PLA microcapsules plays a role in targeted contrast agent performance.

D2 Breast Cancer Detection Using Piezoelectric Fingers (PEFs)

Authors:
H. Yegingil, W.Y. Shih, W.H. Shih, J. Justin, S. Jagtap, and A. Brooks

1Drexel University, Department of Materials Science and Engineering, Philadelphia, PA
2Drexel University, College of Medicine, Philadelphia, PA

Abstract:
A piezoelectric finger (PEF) is a piezoelectric cantilever consisting of a driving and a sensing piezoelectric layer such as lead zirconate titanate (PZT) bonded to nonpiezoelectric layer, e.g., stainless steel. With the dual electrode design, a PEF can both apply a force and detect the resultant displacement with one single device. We have demonstrated that a PEF can measure both the elastic and shear moduli of tissues. Furthermore, we can locate and determine the size of a tumor non-invasively. By comparing the shear and elastic moduli of a tumor, we have the potential to differentiate malignant tumors from benign ones non-invasively. This unique ability of PEF stands to greatly aid tumor malignancy test accuracy.

D3 Rapid, Simultaneous, Label-Free Detection of Multiple Protein Interactions with Altagram Sensitivity

Authors:

1Drexel University, Department of Materials Science and Engineering, Philadelphia, PA

Abstract:
We have developed array lead magnesium niobate-lead titanate/tin (PMN-PT/tin) piezoelectric microcantilever sensors (PEMS) and lead zirconate titanate/SiO_2 (PZT/SiO_2) PEMS that offer the advantages of simultaneous, array, rapid, in-situ, label-free detection of multiple antigens in an aqueous environment. With array PMN-PT/tin PEMS 300 mm in length, we have demonstrated in in-situ, simultaneous, array detection of PSA-antiPSA, EGFR-antiEGFR, HER2-antiHER2, GP120-ANTI-GP120 interactions in concentrations less than 1 ng/ml in a volume ranging 100 ml-1ml. The PZT/SiO_2 PEMS less than 60 mm in length offers better than 10^{13} g/Hz sensitivity, which represents the mass of less than 1000 protein molecules.

D4 Non-Heavy Metal Quantum Dots for Biomedical Application

Authors:
H. Li, W.Y. Shih, and W.H. Shih

1Drexel University, Department of Materials Science and Engineering, Philadelphia, PA

Abstract:
Quantum dots (QDs) are semiconductor nanocrystals that exhibit distinctive photoluminescence properties due to the quantum confinement effect. We have developed a unique aqueous synthesis route to produce highly luminescent non-heavy metal ZnS QDs capped with carboxylated molecules in one single step. They differ from commercial quantum dots in that they do not contain toxic heavy
metals and that they are very small, ideal for in-vivo biomarker applications. The carboxyl-capped QDs are 2-5 nm in size, biologically-benign, stable, and ready for conjugation with proteins or other biomolecules as fluorescence markers for molecular tracking and disease diagnoses.

D5 Detection of Heart Transplant Rejection Using Raman Spectroscopy

Authors:
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¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Division of Cardiology, CoM, Philadelphia, PA

Abstract:
Acute cardiac rejection by internal immune system is the major limitation to the successful heart transplantation. As a current gold standard, an endomyocardial biopsy from a transplanted heart is taken and the degree cardiac rejection is determined pathologically under a microscope after H&E staining. The goal of our research is to ultimately replace this biopsy procedure with optical diagnostic, namely Raman spectroscopy. Here we have successfully demonstrated Raman spectroscopy’s ability to distinguish between Grade-0 and Grade-2 heart transplant rejections. According to 2004 ISHLT (International Society for Heart and Lung Transplantation) cardiac rejection grading system, significant myocyte damage is identified in biopsies from Grade-2 and above. Raman spectroscopy, i.e. optical diagnostic without physically removing the heart tissues with biopsy, could therefore be potentially beneficial for patients with higher grade cardiac rejections as they require more frequent surveillance biopsies that have been shown to increase the mortality rate.

D6 Microencapsulated Doxorubicin in PLGA for Use in Ultrasound Triggered Drug Delivery

Authors:
J. Eisenbrey¹ and M.A. Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
Doxorubicin is a key chemotherapeutic for targeted drug delivery due the fact that at high concentrations it has been linked to significant heart toxicity, and other severe side effects such as nausea and hair loss. We describe studies of doxorubicin absorbed onto the surface of 1-2 micron poly(lactic-co-glycolic acid) (PLGA) contrast agents (CA). Conditions were identified in which the drug-loaded CA retains a high echogenic response in vitro when insonated at 5MHz. Further, it was successfully shown that ultrasound could trigger the release of the doxorubicin from these micro capsules in vitro.

D7 Drug-loaded Contrast Agents for Cancer Diagnosis: A Combination of Imaging and Therapy

Authors:
O. Mualem Burstein¹ and M.A. Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
The objective of our research is to develop methods to produce new generation ultrasound contrast agents (CA) having the added capability of serving as drug carriers. Combining imaging and drug delivery functions will enable delivery of relatively high local doses of chemotherapeutic drugs directly to tumors, triggering their release by US, thus, minimizing toxic side effects and elevating effectiveness. We investigate incorporation of Doxorubicin, a chemotherapeutic drug, into PLA (Poly-lactic acid) microcapsules, previously developed in our lab as ultrasound CA and monitor drug release methods. Effects of preparation and loading on physical (size, shape, texture) and acoustic properties were studied.
Heterogeneity and Drug Delivery

Authors:
A. P. Vamvakidou1, M. J. Mondrinos1, S. P. Petushi1, F. Garcia2, P. I. Lekes1, and A. Tozeren1
1Drexel University, School of Biomedical Engineering, Philadelphia, PA
2Drexel Univesity, Department of Pathology, CoM, Philadelphia, PA

Abstract:
Breast tumors are typically heterogeneous and contain diverse subpopulations of tumor cells with differing phenotypic properties. This study has developed an in vitro co-culture-based three-dimensional breast tumor model that studies the effects of mixing heterogeneous tumor cell populations. Breast cancer cell lines of different phenotypes (MDAMB231, MCF7 and ZR751) were co-cultured in a rotating wall vessel (RWV) bioreactor to form a large number of heterogeneous tumoroids. Prior to each experiment, cells were labeled with cell tracker dyes to allow for time-course fluorescence microscopy to monitor cell aggregation. Histological sections of the tumor spheroids were stained with hematoxylin and eosin (HE), progesterone receptor (PR), E-cadherin (E-cad) and proliferation marker, ki67. Results showed that heterogeneous tumoroids reflected the composition the growth rate, invasion potential, and spatial distributions of heterogeneous tumor spheroids were highly dependent on cell composition. A suitable in vitro model for studying tumor-cell heterogeneity and reciprocal interactions will accelerate understanding of tumor cell phenotype population dynamics.

D9 Gait Energy Efficiency in Children with Cerebral Palsy

Authors:
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1Drexel University, School of Biomedical Engineering, Philadelphia, PA
2Shriners Hospital for Children, Philadelphia, PA

Abstract:
Children with Cerebral Palsy (CP), the most common neuromuscular disorder in children, expend up to three times the energy required for ambulation in typically developed children. We are developing a computational measure of gait energy efficiency based on biomechanical parameters that would reflect energy cost during ambulation in children with CP. Preliminary data were collected and processed at Shriners-Philadelphia motion laboratory. Statistical analysis shows oxygen cost highly correlates to several biomechanical variables. Results support further development of our model that would provide a basis for future devices that more accurately capture energy requirements of gait in this population.

D10 An Introduction to Bionanotechnology: An Interdisciplinary Educational Program

Authors:
A. Parthasarathy1, E. Papazoglou1, K. Barbee1, and P. Leikes1
1Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
Nanotechnology is evolving into a powerful tool and education at the college level is necessary to transform the opportunities into useful biomedical applications. Also appropriate policy decisions regarding safety and use of Bionanotechnology can occur only when thorough research results are disseminated to the public. Drexel Biomed is leading in creating novel lecture, book and lab materials for Bionanotechnology. Thus evolved the program Bionanotechnology, providing scientific knowledge to students via courses and reaching the research scholars through an introductory book.

D11 Optical Properties of Animal Tissue as Diabetes Progresses

Authors:
M. Weingarten3, E. Papazoglou1, L. Zubkov1, L. Zhu1, K. Pourrezaei1, and S. Tyagi2
1Drexel University, School of Biomedical Engineering, Philadelphia, PA
2Drexel University, Department of Physics, Philadelphia, PA
3Drexel University, College of Medicine, Philadelphia, PA

Abstract:
Diffuse photon density wave methodology in the near infrared range was used to calculate absorption and scattering in wounds of healthy and diabetic rats. Differences observed as diabetes progresses can be...
correlated to the delayed healing observed in diabetics.

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D12 Development of a Flow Cytometry Based Assay for Defective T-Cell Signal Transduction in the Rotating Wall Vessel Bioreactor

Authors:  
D. Simons and P. Lelkes  
1Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:  
Dysfunction of T cell signal transduction is responsible for many immune-mediated diseases as well as in aging. Rotating wall vessel (RWV) bioreactors offer a unique environment, in which pathologies due to signaling dysfunction can be mimicked non-pharmacologically. There is an urgent un-met clinical need for developing a flow cytometric assay to rapidly measure signal transduction by T cells cultured in an RWV bioreactor as a means for developing meaningful therapeutic approaches. Our goal is to develop and optimize such an assay in for of a user-friendly kit as a high throughput method for testing immune-ameliorative drugs in the RWV.

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D13 Handheld Tumor Scanner for Breast Cancer Detection

Authors:  
Z. Zhao, J. Zhang, J. Du, S. Nioka, and B. Chance  
1University of Pennsylvania, Dept. of Biochemistry and Biophysics, Philadelphia, PA

Abstract:  
The amplitude cancellation of in-phase and out of phase of dual source single detector showed remarkable sensitivity to localize small object such as breast tumor with positional accuracy of millimeters. The system design of low frequency, battery operated, mini handheld scanner based the principle of amplitude cancellation is introduced, and performance is evaluated on the phantom simulated the optical properties of tissue and tumor. Some clinical test results is showed.

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D14 Development of a Smart & Novel Chimeric Antibody Drug Antagonist to Epidermal Growth Factor for Improved Cancer Therapy

Authors:  
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1Drexel University, School of Biomedical Engineering, Philadelphia, PA  
2Drexel University, Department of Biochemistry, Philadelphia, PA  
3Thomas Jefferson University, Department of Dermatology & Cutaneous Biology, Philadelphia, PA

Abstract:  
Monoclonal antibodies (mAbs) to the extracellular domain of epidermal growth factor receptor (EGFr) have shown potential as therapeutic agents for epithelial malignancies. These mAbs typically inhibit the binding of EGFr ligands thereby blocking receptor activation and subsequent signal transduction. Using BIACore surface plasmon resonance we determined binding kinetics of two EGFr mAbs; C225 (Cetuximab/Erbitux) which is FDA approved for metastatic colorectal cancer and mAb425 (EMD59000) whose humanized version (EMD72000) is currently in phase II clinical trials for various solid tumors expressing EGFr. We report for the first time that these two mAbs bind to distinct epitopes on the extracellular domain of EGFr. Preliminary experiments assessing mAb binding to whole cells confirmed independent binding of both mAbs to the wild type receptor and to the mutant receptor (EGFrVIII) which is prominently expressed in tumor cells. Thus, combined use of mAb425 and C225 in cancer therapy is possible and could provide advantages over the use of the two antibodies as single agents.
D15 Use of Non-Thermal Atmospheric Pressure Plasma Discharge for Coagulation and Sterilization of Surface Wounds

Authors: G. Fridman¹, A. Fridman², A. Gutso³, V. Vasilyt², G. Friedman², L. Peddinghaus³, M. Balasubramanian¹, and A. Brooks³
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³Drexel University, College of Medicine, Philadelphia, PA

Abstract: Thermal plasma discharges have been widely used in the past for treatment of living human tissue; however, an extensive thermal damage occurs due to extreme temperatures. Some solutions have been offered where the temperature is lowered via short current pulses, the addition of noble gases, or a decrease in the size of treatment electrodes. The presented Floating Electrode Dielectric Barrier Discharge plasma is proven electrically safe to humans and reported results show no visual or histological (microscopic) damage to skin samples in minutes, complete tissue sterilization from skin flora in seconds, and blood clot formation in seconds of electric plasma treatment.

D16 Preparation of Nanosomes for Trans-Dermal Delivery of Vitamin C for Reversing Skin Damage

Authors: N. Kulkarni¹, B. Khalique¹, E. Papazoglou¹, and N.S. Babu²
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Department of Materials Science & Engineering, Philadelphia, PA

Abstract: Ultraviolet ray exposure leads to damage to the skin. Vitamin A (Retinol), and to a lesser degree vitamins C and E have been found useful in reversing the damage. One of the effective ways to deliver these vitamins to the skin is by encapsulating them in nanosomes. Currently, state of the art liposomes for trans-dermal delivery of drugs are of size 150-200 nm. We report a method for preparing nanosomes that are below 120 nm in diameter for effective trans-dermal delivery of vitamin C. The nanosomes were prepared by extrusion of multi-lamellar vesicles through a polycarbonate membrane and alumina membrane of various pore diameters. Stability and particle size distribution were compared between nanosomes extruded using polycarbonate membrane and alumina membrane.

D17 Mathematical Model Based On Queuing Theory to Predict the Controlled Diffusion In Alginate / PEG Hydrogels

Authors: S. Gadkari¹, L. Stephansky¹, E. Papazoglou¹, and N.S. Babu²
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Department of Materials Science & Engineering, Philadelphia, PA

Abstract: A mathematical model based on queuing theory to understand the in-vitro uptake of methylene blue by alginate-PEG (Alg:PEG) hydrogels, with varying ratio of alginate to PEG is reported. The diffusion coefficients obtained by the queuing theory are compared with the established models such as the Wagner's constant volume model. Experimental data indicate higher rate of diffusion for 1:2 (Alg:PEG) hydrogel when compared with 1:1 (Alg:PEG). Although Wagner’s model predicts a linear relationship between the amount of PEG and the diffusion coefficient, it could not explain the sudden increase in the rate of diffusion for 1:2 (Alg:PEG) hydrogels. However, the diffusion coefficient calculations made with our model based on queuing theory yield values that fit the experimental observations. The behavior of the diffusion coefficient is attributed to the electrostatic interactions between methylene blue and alginate. Since queuing theory considers diffusion process as a stochastic rather than simple mass transfer process we propose this model as a suitable alternative for understanding hydrogel diffusion.
D18 Loading Carbon Nanotubes with Viscous Fluids and Nanoparticles – A Simpler Approach

Authors:
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¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, College of Medicine, Philadelphia, PA
³Drexel University, Department of Materials Science & Engineering, Philadelphia, PA

Abstract:
A simpler, cost effective, scalable method for filling carbon nanotubes with polymer solution and nanoparticles is reported. The loading of nanotubes (250 nm diameter) was achieved by centrifugation in the presence of the fluid to be loaded. Nanoparticles (polystyrene latex beads and quantum dots) of various sizes (10 to 100 nm) were mixed with the polymer solution prior to centrifugation. This method was found to be effective for loading nanoparticles up to 40 nm in diameter. Higher rate of sedimentation of particles larger than 40 nm resulted in reduction of loading efficiency. At least one tip of the carbon nanotubes was found to be sealed completely after crosslinking the loaded polymer. Loading efficiency was found to depend on the viscosity of the polymer solution. Scanning electron microscopy and confocal laser scanning microscopy were used to analyze the carbon nanotubes after loading. This method is anticipated to be useful in drug delivery especially subcutaneous and slow release formulations.

T1 Effects of Encapsulated BDNF-Producing Fibroblasts on Dorsal Root Ganglia Neurite Growth

Authors:
N. Francis¹ and M.A. Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
Fibroblasts genetically engineered to produce Brain-Derived Neurotrophic Factor (FB/BDNF) have been shown to promote axonal regeneration in the injured spinal cord of an immune-suppressed rat. To avoid immune suppression and protect the cells from the host immune response, FB/BDNF were encapsulated in various alginate gels. BDNF secreted by the fibroblasts was able to diffuse out of the alginate and remain bioactive, stimulating significantly more neurite growth than alginate without encapsulated fibroblasts. A BDNF concentration gradient was also shown to guide DRG neurite growth towards the source. These positive neurotrophic effects show promise as a repair strategy for spinal cord injury.

T2 Development of an Implantable Alginate Scaffold for the Treatment of Spinal Cord Trauma

Authors:
M. Shanbhag¹ and M.A Wheatley¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
Spinal cord injury usually causes permanent disability. An obstacle of treatment is the formation of scar tissue at the site of injury, which prevents the delivery of neurotrophic factors. Alginate administration at the site of injury has shown to reduce scar formation. Implantation of fibroblasts that produce neurotrophic factors have shown to promote regeneration. An alginate scaffold was developed to allow for the diffusion of BDNF to the injury while protecting the fibroblasts from an immune response. This scaffold was seeded with undifferentiated N2a cells. After 7 days, the NB2a cells showed an unusually high amount of proliferation and neurite outgrowth without the addition of differentiating factors. This shows potential to make this approach a viable strategy for delivery of neurotrophic factors in the body.
T3 Tissue Engineering Technologies for Cardiac and Neuronal Applications: Intelligent Scaffolds Made by Electrospinning, Lyophilization, and Critical Point Drying

Authors: M. Li¹, A. Perets¹, and P. Lelkes¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract: Tissue engineering is a rapidly growing area that aims to create, repair and/or replace tissues and organs by using combinations of cells, biomaterials, and/or biologically active molecules. Amongst the most challenging goals in the field of neuronal and cardiovascular tissue engineering is the creation of engineered functional task-specific tissue constructs. In this study, we summarize three tissue engineering scaffolding technology platforms that could be used to grow functional tissue constructs for several clinical applications, such as repair of spinal cord injury, or of irreversible myocardial damage, and thus significantly improve the quality of life for millions of patients.

T4 Porogen-Based Solid Freeform Fabrication of Smart “Tools” for Orthopedic Surgery, Tissue Engineering and Regenerative Medicine

Authors: J. Zhou¹, L. Lu¹, F. Kleinbart², N. Johanson², and P. Lelkes³
¹Drexel University, Department of Mechanical engineering and Mechanics, CoE, Philadelphia, PA
²Drexel University, Department of Orthopedic Surgery, CoM, Philadelphia, PA
³Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract: There is an urgent unmet clinical need for smart “tools” and hardware that can actively participate in and accelerate the healing processes in orthopedic surgery. We will use solid freeform fabrication and injection molding techniques for manufacturing surgical “tools”, such as screws and anchors, that exhibit mechanical strength comparable to/better than existing metal or plastic “tools” and contain bioactive components e.g., growth factors tailored to specific applications and the personalized requirements of recipient patient. We anticipate that we will be able to rapidly test these prototype “smart/intelligent” screws/anchors in animal models for the accelerated repair of bones, tendons and ligaments.

T5 Alimentary Protein-Based Scaffolds for Personalized Tissue Engineering and Regenerative Medicine

Authors: A. Katsir¹, D. Woerdeman², L. Lin¹, M. Weingarten³, and P. Lelkes¹
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Department of Physics, Philadelphia, PA
³Drexel University, Department of Surgery, CoM, Philadelphia, PA

Abstract: There is an urgent un-met clinical need for novel, bioactive, biodegradable, cost-effective scaffolds for wound dressing and numerous surgical applications. Our long-term goal is to generate nanofibrous electrospun scaffolds based on personalized requirements of individual patients. We propose to use pure alimentary proteins, such as soy, corn, wheat, etc., as basis for cellular and acellular scaffolds in non healing wounds and diabetic venous ulcers. Given our advanced technological capabilities, we anticipate that we will be able to manufacture and rapidly test in animals and in patients novel packaged, ready-to-use, off-the-shelf scaffolds as wound dressings and for surgical applications.
T6 Dynamic Hi-Resolution Horizontal Microscope for Monitoring and Manipulating Real-Time Tissue Assembly

Authors:
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\textsuperscript{1}Drexel University, Graduate School, CoM, Philadelphia, PA
\textsuperscript{2}Drexel University, School of Biomedical Engineering, Philadelphia, PA

Abstract:
There is an un-met clinical and technological need in regenerative medicine and tissue engineering for developing a non-invasive technique for monitoring and manipulating tissue assembly. Our goal is to create an integrated hardware/software system to automatically diagnose, monitor, and control tissue growth in dynamic bioreactors in real-time. For this we propose to engineer and test a versatile, high-resolution horizontal microscope that can intelligently aid in the on-line optimization of tissue growth parameters within a bioreactor. Having developed a functional prototype, we succeeded in compacting and significantly reducing the costs for the 2\textsuperscript{nd} generation system, which now needs further validation.

T7 Engineered Tissue Models for Drug Development: The Lung as a Paradigm

Authors:
M. Mondrinos\textsuperscript{1}, S. Koutzaki\textsuperscript{2}, C. Finck\textsuperscript{3}, and P. Lelkes\textsuperscript{1}
\textsuperscript{1}Drexel University, School of Biomedical Engineering, Philadelphia, PA
\textsuperscript{2}St. Christopher’s Hospital for Children
\textsuperscript{3}College of Medicine, Drexel University, Philadelphia, PA

Abstract:
There is an un-met clinical and technological need for developing high-fidelity tissue models for high-throughput drug discovery. Tissue engineering is a viable means for engineering functional tissue equivalents, which hold the promise of revolutionizing the pharmacological industry by providing novel venues for high throughput drug testing. Working at the interface between applied developmental biology/medicine and tissue engineering we propose to generate such functional tissue equivalents, using the distal lung as our prime paradigm. With such model tissue we will demonstrate physiological responses, induce pathological conditions, and test therapeutics in disease models, such as pulmonary hypertension and emphysema.
N1 Effects of Shear Stress Injury on the Morphology and Structure of Cultured Chick Forebrain Neurons

Authors:
K. Barbee¹, D. Kilinc¹, and G. Gallo²
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Department of Neurobiology and Anatomy, CoM, Philadelphia, PA

Abstract:
We applied fluid shear stress injury (FSSI) to cultured chick forebrain neurons to determine if this type of injury mimics the structural and morphological changes in central nervous system neurons following traumatic brain injury (TBI). Our results demonstrate that axonal beading, which is the hallmark of TBI, is increased following FSSI, suggesting that our in vitro model system mimics TBI-like changes observed in vivo. Beads appeared at distinct locations along the axon where microtubule (MT) mass is decreased, supporting the hypothesis that beading is related with impaired axonal transport conducted over MTs. We suggest that focal changes in axolemmal permeability following trauma is responsible for focal peaks of intracellular calcium, which, in turn, depolymerize MTs locally. We are currently investigating if focal peaks of calcium exist and if axolemmal permeability changes occur in response to FSSI.

N2 Nanostructured Porous Silicon Scaffolds and Augmented Surface Coatings for Enhanced Biocompatibility of Multi-channel Microelectrodes

Authors and Affiliations:
S. Hallman¹, K. Barbee¹, and K. Moxon¹
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Abstract:
Many different types of microelectrodes have been developed for use as a direct Brain-Machine Interface (BMI) to chronically record. Unfortunately, the recordings from these microelectrode devices are not consistent and often last for only a few weeks. The loss of these recordings is most likely due to damage to surrounding tissue that results in the formation of non-conductive glial-scar. In conjunction with developing nanostructured electrode surfaces to mimic the extracellular environment, we have also begun to study the effects of novel surface coatings. Preliminary data show that Poloxamer has a positive effect on neuronal survival and is successful in decreasing the proliferation of glial cells.

N3 Multi-site Analysis of Dopamine Uptake in the Somatosensory Cortex

Authors:
A. Khair¹, C. Randall¹, and K. Moxon¹,²
¹Drexel University, School of Biomedical Engineering, Philadelphia, PA
²Drexel University, Department of Neurobiology and Anatomy, CoM, Philadelphia, PA

Abstract:
Voltammetry has been used as a method to measure the concentration of monoaminergic neurotransmitters in-vivo. Studies have shown that the concentration of neurotransmitters, such as dopamine, varies across small regions of the brain (less than 1mm). To study the varying concentration of dopamine, a multi-site electrode would be beneficial. Therefore, the recording sites of our ceramic-based multi-site electrode were coated with carbon and deployed in the somatosensory cortex of a rat. Known concentrations of dopamine were pressure injected and the diffusion curve, which is the change in concentration over time, was recorded. The results show that the in-vivo data does not follow the prediction of the model providing an interesting insight to the uptake of monoamines across the different layers of the somatosensory cortex.
N4 Brain Computer Interface using Functional Near Infrared (fNIR) Spectroscopy

Authors:
H. Ayaz1, T. Heiman-Patterson2, M. Schultheis1, M. Izzetoglu1, and B. Onaral1
1Drexel University, School of Biomedical Engineering, Philadelphia, PA
2Drexel University, Department of Neurology, CoM, Philadelphia, PA

Abstract:
The ideal non-invasive brain computer interface (BCI) transforms signals originating from human brain into commands that can control devices and applications. This has significant advantage for those individuals suffering from neuromuscular impairments such as Amyotrophic Lateral Sclerosis (ALS) or various types of paralysis. In this study we propose to design a new noninvasive BCI that is based on optical means to measure brain activity as opposed to traditional EEG (Electroencephalogram) based approach. Proposed system will use functional near infrared (fNIR) spectroscopy to detect cognitive activity from prefrontal cortex elicited by a mental task. Efficacy of the proposed design will initially be studied on healthy individuals at Optical Brain Imaging Lab and later on ALS patients at Drexel College of Medicine.

N5 ACOBI: A Tool For Registering fNIR Data to Brain Surface Image

Authors:
H. Ayaz1, S. Platek2, S. Bunce3, K. Izzetoglu1, B. Onaral1, and K. Pourrezaei1
1Drexel University, School of Biomedical Engineering, Philadelphia, PA
2Drexel University, Department of Psychology, CoAS, Philadelphia, PA
3Drexel University, Department of Psychiatry, CoM, Philadelphia, PA

Abstract:
Functional near-infrared spectroscopy (fNIR), which assesses changes in the relative levels of oxygenated and deoxygenated hemoglobin, has increasingly been used to assess neural function in the cortex. Unlike positron emission tomography (PET) and magnetic resonance imaging (fMRI), functional brain imaging via fNIR is a relatively new research field that lacks brain-mapping tools designed to allow researchers and clinicians to interact with their data. Analysis for Cognitive Optical Brain Imaging Studio (ACOBI) is a software program that has been developed to address this challenge. ACOBI is a post-processing environment that encompasses analytic and visualization techniques devoted to a better understanding of the relationship between behavior and fNIR signals.

N6 Maze Suite: A Complete Set of Tools To Prepare, Present and Analyze Navigational & Spatial Cognitive Neuroscience Experiments

Authors:
H. Ayaz1, S. Levin2, S. Platek2, and B. Onaral1
1Drexel University, School of Biomedical Engineering, Philadelphia, PA
2Drexel University, Department of Psychology, CoAS, Philadelphia, PA

Abstract:
Maze Suite is a complete set of tools that enables researchers to perform spatial and navigational behavior experiments within interactive, easy to create, and extendable (e.g., multiple rooms) 3D virtual environments. Maze Suite can be used to design/edit adapted 3D environments where subjects’ behavioral performance can be tracked. Maze Suite consists of three main applications; an editing program to create and alter maps (MazeMaker), a visualization/rendering module (MazeWalker), and finally an analysis/mapping tool (MazeViewer). Additionally, Maze Suite has the capabilities of sending signal pulses to physiological recording devices using standard computer ports. Maze Suite, with all 3 applications, is a unique and complete toolset for researchers who want to easily and rapidly deploy interactive 3D environments.
N7 FNIR for the Assessment of Cognitive Impairments Following Traumatic Brain Injury

Authors:
M. Schultheis\textsuperscript{1,2}, M. Izzetoglu\textsuperscript{1}, and A.C. Merzagora\textsuperscript{1}
\textsuperscript{1}Drexel University, School of Biomedical Engineering, Philadelphia, PA
\textsuperscript{2}Drexel University, Department of Psychology, CoAS Philadelphia, PA

Abstract:
Traumatic brain injury (TBI) often involves serious cognitive complications. Recovery is primarily assessed through behavioral observation, which provides little information about changes at the brain level. In order to investigate functional brain activity during everyday life tasks, this research will employ a safe, affordable and portable neuroimaging modality: functional near-infrared spectroscopy (fNIRS). The study is a preliminary establishment of fNIRS as a clinically useful tool in TBI neuro-rehabilitation. First, fNIRS measures will be tested for their ability to discriminate between TBI patients and healthy controls. Then, fNIRS measures will be compared to performance on traditional cognitive tasks and EEG analyses.

N8 Portable Near-Infrared Technology for Detection of Traumatic Brain Injuries in Operational Environments

Authors:
B. Ben Dor\textsuperscript{1}, B. Onaral\textsuperscript{2}, and B. Chance\textsuperscript{3}
\textsuperscript{1}InfraScan Inc., Philadelphia, PA
\textsuperscript{2}Drexel University, School of Biomedical Engineering, Philadelphia, PA
\textsuperscript{3}University of Pennsylvania, Department of Biochemistry and Biophysics, Philadelphia, PA

Abstract:
An estimated two million individuals seek medical treatment for head trauma in the U.S. each year, and the worldwide incidence of head trauma is estimated at approximately ten million individuals. While CT scans are currently the diagnostic standard for hematomas, many head trauma patients do not immediately receive a CT scan due to logistics related to accident site and in many remote areas, due to lack of CT scan equipment availability. Yet for patients with brain hematomas, prompt remedial action is essential to maximize preservation of life and brain function. The Infrascanner addresses this unmet medical need for a simple, portable, accurate, and cost effective hematoma detection device for use in a variety of settings, including hospital emergency rooms and intensive care units.

N9 Adaptive Deep Brain Stimulation for Neurological Disorders: Pre-Clinical and Clinical Testing of the FilterDBS System

Authors:
G. Foffani\textsuperscript{1}, K. Moxon\textsuperscript{1}, and A. Priori\textsuperscript{2}
\textsuperscript{1}Drexel University, School of Biomedical Engineering, Philadelphia, PA
\textsuperscript{2}Università di Milano, IRCCS Ospedale Maggiore di Milano, Department of Neurological Sciences, Milano, Italy

Abstract:
Deep brain stimulation (DBS) is an effective treatment for advanced Parkinson’s disease. The main limit of DBS therapy is the lack of automatic parameter adjustment and the inability to continuously adapt to the striking clinical fluctuations characterizing the disease. This is a critical problem for maximizing DBS clinical efficacy in individual patients and for efficiently extending the indication of DBS to other socially relevant neurological and psychiatric diseases. To overcome these limitations, the 	extit{long term goal} of this proposal is to develop an adaptive DBS system that continuously monitors the neurophysiological effects of the therapy and automatically adjusts the stimulation parameters to maximize clinical efficacy (patent application submitted). The 	extit{objective} of this proposal is to show the feasibility of using local field potentials (LFPs) as the neurophysiological feed-back signal for the adaptive DBS system. The 	extit{central hypothesis} is that our working prototype, the FilterDBS, can record LFPs from DBS electrodes 	extit{during} DBS and can therefore continuously monitor DBS-induced changes of subthalamic activity in patients with Parkinson’s disease. Our milestones include pre-clinical and clinical testing of the prototype. The proposed research is significant to clarify the mechanisms implicated in the clinical improvement produced by DBS, to maximize DBS clinical efficacy in individual patients and to efficiently extend DBS indications to other socially relevant neurological/psychiatric disorders.
Biomedical Technology Showcase 2006 is organized by the Translational Research in Biomedical Technologies (TRBT) Program of the School of Biomedical Engineering, Science and Health Systems.

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