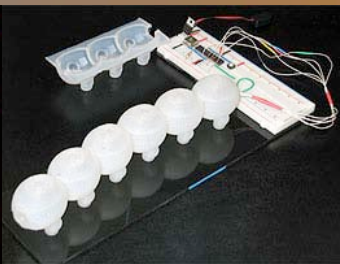
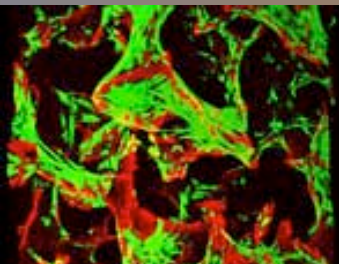


BME Bulletin



Biomedical Engineering Department

Spring 2010, Volume IV

Letter from the department chair

A new faculty member joins BME, students and alumni receive recognition, and research programs flourish, highlighting accomplishments of the past year



Another year has passed and the Department continues to thrive. Despite the challenging economy, the Department grew with the addition of a new tenure-track faculty member.

Lauren Black, PhD joined us, bringing expertise in the field of myocardial tissue engineering. Our first class of graduating seniors moved on to a range of exciting opportunities, and our graduate students and post doctoral associates populated academic and industrial laboratories after completing their programs. Our current students and colleagues continue to receive recognition and awards: summer internships, and research awards via Tufts, the NSF, NIH, DoD, and the Fulbright program, to name a few.

Biomedical engineering continues to make the future, not just respond to the present, by anticipating needs that interface engineering and clinical medicine. In many respects, biomedical engineering is the educational mode of the future, fostering collaborations among disciplines at its core by building on basic concepts in engineering and biology. We strive to educate where the needs, opportunities and jobs are and will be in the future. The bridge between engineering, biology and medicine is a growing link and there is no sign that this interface will slow. With an

aging population, dynamic changes in healthcare, global economies and related themes upon us, we are only at the very beginning of the impact that biomedical engineering will have on medicine and quality of life. Those of us in Biomedical Engineering are excited to be setting this agenda and welcome your participation. In part, this is why we have designed our BME major to cover both depth and breadth, always a challenge, but one that we are committed to. The depth of research experience, coursework, study abroad options, and internships all convene to establish a solid foundation for our students as they embark on their career paths.

To our alums, colleagues and friends, we welcome your feedback, participation and ideas to continue to help us move ahead in our educational and research programs. We wish to engage you to establish a strong network of support and opportunity for our students and colleagues and to keep open communication to integrate diverse and important perspectives, and help us map future directions for our program as we mature.

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biomaterials workshop in africa



From Top: Mauritian landscape; Prof. Kaplan's opening conference remarks; Mauritian waterfall. Photos courtesy Mike Brown.

The island nation of Mauritius, located 500 miles off the coast of Madagascar, hosted a first of its kind workshop in the Indian Ocean region called Biomaterials: Perspectives and Possibilities from November 30th through December 4th, 2009 at the University of Mauritius, Reduit. The workshop was funded by the National Science Foundation (NSF) and organized by Professor David Kaplan of Tufts University in collaboration with Professor Dhanjay Jhurry of the University of Mauritius.

The focus of the conference was on the state of the art in biomaterials research and each of the five days focused on a specific, unifying theme: biomaterials, regenerative medicine, drug delivery, nanotechnology/biosensors, and government/industry issues in the Indian Ocean region. An accomplished group of faculty was recruited to run the workshop and various Mauritian Ministries were in attendance to facilitate a productive meeting and assess the long term impact of biomaterials research in the region.

Faculty from the US that taught the course included: Gary Bowlin, Virginia Tech; Jason Burdick, University of Pennsylvania; Sharon Gerecht, Johns Hopkins; Anthony Guiseppi-Elie, Clemson; Ali Khademhosseini, MIT; Catherine Kuo, Tufts University; Kam Leong, Duke University; and Gordana Vunjak-Novakovic, Columbia University; along with David Kaplan and Dhanjay Jurry. In addition, a BME first major and second-year Gordon Institute student, Michael Brown, attended the workshop, helping to organize the meeting, the reports and the follow on plans.

The major outcomes of the workshop were three fold: 1) the development of a graduate level course in Biomaterials for the University of Mauritius that will be jointly taught by faculty from the US; 2) the initiation of collaborative research efforts between conference participants from Africa, the Indian Ocean Region, Europe, and the US; 3) the planning of follow up projects involving the development of student exchange programs for research, training, and education in biomaterials research.

BME senior theses - class of 2010

Michael Brown (*Omenetto, advisor*) - Silk-based biosensors: A proof of concept

Alexis Burbank (*Kuo, advisor*) - Investigating potential mechanisms of myotendinous junction formation *in vitro*

Rachel Engelberg (*Kaplan, advisor*) - Silk fibroin encapsulated reservoirs for sustained release of buprenorphine

Jonathan Jo (*Kaplan, advisor*) - Characterization of *Manduca sexta* cell culture for bioactuator applications

Victor Liu (*Georgakoudi, advisor*) - *In vitro* flow cytometry of human breast cancer cells

Cherisse Mecham (*Kaplan, advisor*) - Endothelial cell perfusion in a cancer model

Alex Mitropoulos (*Omenetto, advisor*) - Examining the tunability of nature and manmade photonic crystals

Matthew Ryder (*Fantini, advisor*) - Elimination of scalp signal from near infrared spectroscopy of the brain

Christina Thomas (*Kaplan, advisor*) - Vascularization of tissue engineered constructs

Ching-Chieh Wang (*Omenetto, advisor*) - Chlorophyll-based oxygen producing biomaterials for tissue engineering

Lisa Yanushefski (*Kaplan, advisor*) - Methods for selective patterning of neuron growth

welcome to newest BME faculty



Professor Lauren D. Black, III joins the Biomedical Engineering Department as an assistant professor after a post-doctoral fellowship at the University of Minnesota. While there, he received an NIH Pathway to Independence Award (K99/R00) to study the optimal cellular composition for improved myocyte coupling/communication and contraction force while maintaining sufficient gel compaction/construct alignment and mechanical properties. Prior to his fellowship, he earned an MS/PhD in biomedical engineering from Boston University.

Lauren's research interests lie in understanding the biophysical signaling mechanisms responsible for the development of healthy and diseased myocardium inclusive of mechanical stress/strain, electrical simulation, and cell-cell/cell-matrix interactions. The ultimate goal of his research is to design and develop new methods for repairing diseased or damaged myocardium.

graduating grad students (summer 2009 - winter 2010)

Masters of Science

Charles Banos, (Kuo) - The influence of muscle-derived soluble factors on embryonic tendon development *in vitro*

Jeremy Plourde, (Kaplan) - Investigating the use of mineralized silk as a dental biomaterial & interfacial bonding to bone

Sejuti Sengupta, (Kaplan) - In vitro bone tissue engineering with silk biomaterial based system

Nate Zamarripa, (Kuo) - Novel electrospun biomimetic scaffolds for tendon and ligament tissue engineering applications

Tony Zhang, (Kaplan) - Biodome project: Biophysical regulation of murine digit and tail regeneration

Doctorate

Jen Kang Choi, (Kaplan) - Three-dimensional adipocyte/endothelial co-cultures for adipose tissue engineering

Jon Kluge, (Kaplan) - Mechanical characterization of silk-based biomaterials for functional tissue engineering

Ning Liu, (Fantini) - Near-infrared optical mammography: Imaging methods and human subject initial test

Bill Rice, (Georgakoudi) - Optical, non-invasive monitoring of engineered tissues

postdoctoral awards

Philipp Seib, PhD (Kaplan group), received a fellowship from the German government to support studies on breast cancer metastasis.

graduate student awards & fellowships

Biomedical Engineering boasts numerous award winners for graduate student research and teaching.

Jeff Brown (PhD) - Outstanding Graduate Student Contribution to Undergraduate Education

Amy Hopkins (PhD) - Fulbright Scholarship

Michaela Reagan (PhD) - Predoctoral Traineeship from the DoD Breast Cancer Research Program

Lindsay Wray (PhD) - Predoctoral NSF Fellowship

Mary (Katie) Balaconis (MS) - Draper Fellowship

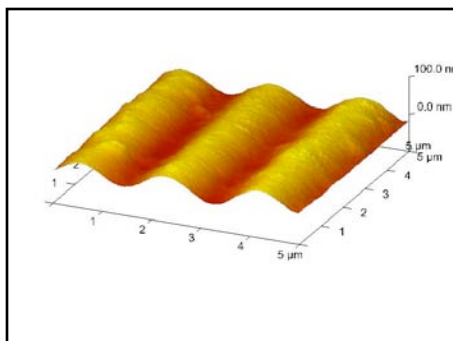
new graduate program in bioengineering

integrates with School-wide initiatives and provides new options for students. For more information, visit the program's website at <http://engineering.tufts.edu/academics/gradprograms/bioengineering.htm>.

The School of Engineering has embarked on a new graduate initiative in Bioengineering. This is a masters level program to provide educational opportunities reflective of the robust biomedical device, hospital and research community in Boston and New England. BME offers a specific track in biomaterials, providing specialty for those interested in an in-depth graduate exposure in this field. This program is in addition to the BME graduate programs at the PhD and Masters level, while the new program

departmental research highlights

Cronin-Golomb Lab



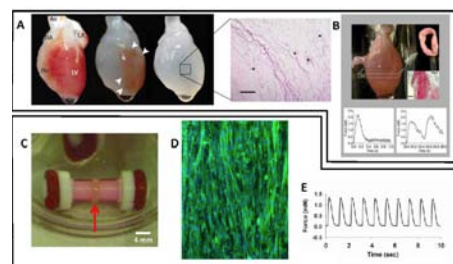
It is known that polymers containing azobenzene exhibit a wealth of photo-induced processes. There has also been extensive research on the use of silk fibroin as a biocompatible material for the production of replicated and micro-machined optical devices for various biomedical sensing applications. **We have shown recently that azobenzene functionalized silk (AFM image above) is effective as a nonlinear optical material** and shows many of the same features as sol-gels. These effects are thought to be due to optically induced transformation of azobenzene.

Omenetto Lab



Omenetto's group is revisiting biopolymers in a high-tech context: silk fibroin extracted from silkworm cocoons is a unique biopolymer that combines biocompatibility and implantability with optical properties. Silk can be nanopatterned to create holographic gratings, phase masks, beam diffusers, and photonic crystals out of a pure protein film. **The properties of silk allow these devices to be "biologically activated" offering new opportunities for sensing and biophotonic components.** Bio-optical devices can be fabricated by doping silk films with fluorescent materials (such as quantum dots above).

Black Lab



The lab focuses on understanding the biophysical signaling mechanisms responsible for the development of myocardium. **The ultimate goal is to design and develop new methods for repairing diseased or damaged myocardium;** in the following areas: 1) The use of novel methods, such as whole organ decellularization (panels A & B of Figure) to study the role that the local extracellular environment plays in the progression of myocardial disease; 2) development of new methods for cardiac repair following myocardial infarction and heart failure (C, D, & E).

faculty recognition & awards

Sergio Fantini was invited to act as the opponent in a doctoral defense at the Department of Biomedical Engineering and Computational Science at the Helsinki University of Technology, Finland. The doctoral candidate, Tommi Nojonen, defended a doctoral dissertation on "Instrumentation and Methods for Frequency-Domain and Multimodal Near-Infrared Spectroscopy." The formal proceedings (including a public 2-hour examination of the candidate solely by the opponent) were followed by a dinner with a formal dress code (Pictured: Prof. Fantini (opponent), Prof. Merilainen (supervisor), Mr. Tommi Nojonen).



Greg Altman, PhD (A97, EG02), received the Tufts Young Alumni Distinguished Achievement Award. He is president and CEO of Serica Technologies, Inc. and an active member in the Tufts community through research collaborations as a Research Assist. Prof.



Catherine K. Kuo was featured as a Women Scientist in Action by the NIH in Fall 2009. Her research interests and advocacy work for women in engineering were highlighted.

departmental research highlights

Georgakoudi Lab



Most cancers develop in the uppermost layer of tissue that covers our body cavities and organs. If cancer changes are detected when they are confined to this superficial layer, they can be treated effectively. We are **developing optical, non invasive imaging methods that enable improved cancer detection**. Towards this aim, we have begun to identify optical signals that rely on the ways with which cells and tissues interact with and modify light depending on their biochemical composition and organization.

Fantini Lab



A new collaboration between Sergio Fantini's group and Drs. Roger Graham and Dr. Marc Homer at Tufts Medical Center has resulted in recruitment of patients affected by breast cancer for initial optical mammography tests. **The mammography instrument features a novel spectral approach to tumor oximetry that can result in effective detection of breast cancer and monitoring of individual response to treatment.** The first measurements showed enhanced tumor detection capabilities.

Kuo Lab



An interest of the Lab is to regenerate new tendon tissue from mesenchymal stem cells. Using FV-AFM, we are **characterizing the nanoscale and microscale mechanical properties of embryonic tendon from early to late stages of development**. This study will provide unique insight into the role of forces and matrix properties in musculoskeletal development and enable rational design of scaffolds with which to guide cell differentiation during tissue formation.

Kaplan Lab

The Kaplan Lab published in *Current Literature in Basic Science* on the antiepileptic effects of silk-polymer based adenosine release in kindled rats. The group, with collaborators from Legacy Emmanuel Hospital, reports that **recipients of adenosine-releasing implants were protected from seizures for the duration of the sustained adenosine release**. It was concluded that silk-based adenosine exerts potent anti-ictogenic effects, and might also have at least partial anti-epileptogenic effects. Thus, silk-based adenosine augmentation holds promise for epilepsy treatment.

translating our research to industry

Serica Technologies, Inc.



Serica, founded by BME alum Greg Altman, PhD, was acquired by the healthcare products company Allergan. Serica focuses on the development of biodegradable silk-based scaffolds for use in tissue regeneration in numerous therapeutic areas, including connective tissue repair of the knee.

Ekteino Labs, Inc.



Tufts licensed technology to Ekteino Laboratories, Inc., to advance drug delivery technologies using silk biopolymers developed by Prof. David Kaplan. Ekteino will tap silk's unique biocompatibility, biodegradability, strength, and versatility to achieve controlled and sustained delivery of drugs.

TERC hosts event for talented youth

On Saturday April 10th almost 200 7th – 10th grade students attended a Biotechnology and Bioengineering program sponsored by the Johns Hopkins University Center for Talented Youth. The Tissue Engineering Resource Center served as host for this event, presenting the students and their parents with introductions to stem cells, bioreactors, drug delivery, tissue engineered models of cancer metastasis and several lab demonstrations. Students were largely from New England, although a handful traveled from as far as California to attend this one-day event. The students and postdoctoral associates of TERC and the Biomedical Engineering



department who presented general topics as well as their personal research received rave reviews from the attendees. The day was capped off by a keynote lecture by Dr. David Kaplan where he discussed the future of tissue engineering and regenerative medicine, building on all of the information presented throughout the day.



ATTENTION ALUMNI: WE WANT TO HEAR FROM YOU!

Please take this opportunity to reconnect and share important milestones with your classmates and colleagues.

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