



*Pritzker Distinguished Lecturer:*

## Rebecca Richards-Kortum, PhD

*Department of Bioengineering, Rice University*

THURSDAY, OCTOBER 7, 2010

8:00AM

BALLROOM D, CONVENTION CENTER

### From Cell Phones to Cell Biology: High Tech, Low Cost Solutions for Global Health

**A** **ADVANCES IN THE BIOSCIENCES** and public health are responsible for dramatic gains in life expectancy achieved over the last century. Yet, the majority of the world has not benefited from this progress. Sustainable and scalable innovations to prevent disease are needed. This talk will describe efforts of bioengineering faculty and students to develop new diagnostic and therapeutic tools which can be used at the point-of-care (POC) to improve health in low resource settings.

Advances in MEMS technologies, molecular recognition, and low power sensors now offer the ability to design low-cost, reusable platforms for POC diagnostics. Efforts to integrate molecular imaging together with miniature microscopes are now yielding new POC diagnostics for infectious and chronic diseases. Driven by advances in consumer electronics, high resolution imaging can be obtained with low cost devices; advances in digital signal processing provide the ability to automate analysis.

In parallel, multidisciplinary educational programs are engaging undergraduate students to address POC design problems in developing countries. In creating solutions to real world challenges, students are challenged to think beyond traditional disciplinary and geographic boundaries.

**REBECCA RICHARDS-KORTUM** is the Stanley C. Moore Professor of Bioengineering at Rice University. Previously, she held the Cockrell Family Chair in Engineering #10 and was a Professor of Biomedical Engineering at the University of Texas at Austin, where she was also a Distinguished Teaching Professor. After receiving a B.S. in Physics and Mathematics from the University of Nebraska-Lincoln in 1985, she continued her graduate work at the Massachusetts Institute of Technology, where she received a PhD in Medical Physics in 1990. She joined the faculty in Bioengineering at Rice University in 2005 and served as Chair of Bioengineering from 2005-2008.

She was named a Howard Hughes Medical Institute Professor in 2002 and 2006, and was elected to the US National Academy of Engineering (2008). She was elected fellow of AAAS and of BMES in 2008, and received the IEEE Educational Activities Board Vice-President Recognition Award (2008).

Dr. Richards-Kortum's research group is developing miniature imaging systems to enable better screening for oral, esophageal, and cervical cancer and their precursors at the point-of-care. In collaboration with faculty at the UT MD Anderson Cancer Center, her group has carried out clinical trials of this technique involving over 2,000 patients in the US, India and Nigeria. Her group is developing contrast agents for in vivo molecular imaging of changes associated with precancer including expression of epidermal growth factor receptors. More recently, her group has worked to integrate advances in nanotechnology and microfabrication to develop novel, low-cost sensors to detect infectious diseases at the point-of-care, including cryptosporidium, malaria, and Tuberculosis.

At Rice University, Dr. Richards-Kortum has worked to establish new educational programs in global health technologies, including a new undergraduate minor in global health technologies at Rice. Students in the minor engage in project based courses to solve problems contributed by partners in developing countries. Students in the program have designed over 28 new technologies which have been used by healthcare providers in 15 international healthcare settings and have impacted the lives of over 19,000 people.



*BMES Distinguished Achievement Lecture Award:*

### **Nicholas A Peppas, ScD**

*Fletcher Stuckey Pratt Chair in Engineering*

*Professor of Chemical Engineering, Biomedical Engineering and Pharmacy*

*Chair, Department of Biomedical Engineering*

*Director, Center on Biomaterials, Drug Delivery, Bionanotechnology and Molecular Recognition*

*University of Texas, Austin*

FRIDAY, OCTOBER 8, 2010

8:30AM

BALLROOM D, CONVENTION CENTER

## From Drug Delivery and Targeted Therapeutics to Advanced Intelligent Biomedical Devices for Improved Health Care

**D**URING THE EARLY DAYS of drug delivery studies, forty years ago, the field was considered outside of the main scope of biomedical engineering. Yet, major successes in health care and disease treatment through careful engineering design of advanced drug delivery systems led to maturity of the field, where biomedical transport phenomena and bio-polymer development merged to create a generation of general and targeted drug delivery systems for the treatment of a wide range of diseases. These days, successful targeted delivery systems are designed to allow delivery of therapeutic or diagnostic agents to a preferential site. As targeted nanodelivery involves local delivery of therapeutics and diagnostics at disease sites, this method has received considerable attention and is poised to have a significant impact on medicine. Efficient targeted delivery systems allow for a reduced systemic dosage while resulting in relatively higher or more efficient dosing at the target site. Targeted delivery has become a rich field of drug delivery and nanomaterials. Nanoscale materials are a necessity for most targeted delivery systems as they must be allowed to transport through different tissue spaces in order to localize at the target site. The ability of nanoparticles to localize at a target site is dependent on chemical properties, the presence of a targeting ligand, or size. Even with targeted delivery, only a fraction of the administered dose localizes at the target site while the remaining nanoparticles distribute throughout the body. Pharmacokinetics pertaining to the nanodelivery system determine the dose in non-targeted tissues. Understanding of nanoparticle biodistribution and pharmacokinetics is significant in the successful development and translation of targeted delivery systems. The design of optimized targeted delivery systems is based on the drug or agent of interest, the nanoparticle type that allows sufficient loading of the drug, and the physicochemical properties that allow for targeting. We highlight some of this recent work on targeted delivery systems and focus on in vivo performance, localization, and the incorporation of diagnostic and therapeutic agents in targeted delivery systems.

**NICHOLAS A. PEPPAS** is the Fletcher Stuckey Pratt Chair in Engineering, Professor of Biomedical Engineering, Chemical Engineering and Pharmacy, and Chair of the Department of Biomedical Engineering at the University of Texas at Austin. He is a member of the Institute of Medicine of the National Academies, the National Academy of Engineering, the National Academy of Pharmacy of France, and the Texas Academy of Medicine, Engineering and Sciences. Peppas has been a leader in biomaterials, drug delivery and pharmaceutical bioengineering. The multidisciplinary approach of his research blends modern molecular and cellular biology with engineering to generate the next-generation of medical systems and devices for patient treatment. He has been recognized with the Pierre Galletti Award from AIMBE, several awards from AIChE (Founders Award, William Walker Award, Institute Lecture, Bailey Award, Bioengineering Award, Materials Award), Society for Biomaterials (Founders, Clemson and Hall Awards), Controlled Release Society (Founders, Heller and Eurand Awards) and other Societies. He is a fellow of BMES, AIMBE, AIChE, APS, MRS, SFB, CRS, AAPS, AAAS and ASEE. He is the President of the International Union of Societies of Biomaterials Science and Engineering, the Chair-elect of the BME Chairs Council, and a member of the Board of BMES. Peppas has served as President of the Society for Biomaterials and the Controlled Release Society, as Chair of the College of Fellows of AIMBE, and as Director of AIChE. He was the Editor of Biomaterials from 1982 to 2002. Presently, he is Editor-in-Chief of the SFB/Wiley Biomaterials Book Series and Associate Editor of the Cambridge University Press Biomedical Engineering Series, the AIChE Journal and Biomedical Microdevices. He has published 1100 papers and 45 patents and has supervised the research of numerous postdoctoral and graduate students including 88 PhDs, 37 of them presently professors in other Universities. Dr. Peppas holds a Dipl. Eng. from the National Technical University of Athens (1971), a Sc.D. from the Massachusetts Institute of Technology (1973), and honorary doctorates from the University of Ghent, Belgium, the University of Parma, Italy, and the University of Athens, Greece.



*BMES 2010 Rita Schaffer Memorial - Young Investigator Lecturer:*

### **Cynthia Reinhart-King, PhD**

*Assistant Professor, Cornell University*

SATURDAY, OCTOBER 9, 2010

8:00AM

BALLROOM D, CONVENTION CENTER

## How Matrix Properties Control the Self-assembly and Maintenance of Tissues

**T**HE MECHANISM BY which cells organize into tissues is fundamental to developmental biology and tissue engineering. Likewise, disruption of cellular order within tissues is a hallmark of many diseases including cancer and atherosclerosis. Tissue formation is regulated, in part, by a balance between cell-cell cohesion and cell-matrix adhesion. In this lecture, I will discuss my laboratory's investigation into the role of this balance in the formation of vasculature. Specifically, we have found that by decreasing cell-matrix adhesion by either reducing matrix stiffness or matrix ligand density, endothelial cells self-assemble into network-like structures, resembling capillaries. These structures are stabilized by increased localization of VE-cadherin to the cell membrane and the polymerization of the extracellular matrix protein fibronectin. When fibronectin polymerization is inhibited, network formation does not occur. Interestingly this interplay between substrate mechanics, ECM assembly and tissue self-assembly is not limited to endothelial cells, as we have observed it in other cell types as well. These results suggest novel approaches to foster stable cell-cell adhesion and engineer tissues.

**CYNTHIA REINHART-KING** is an Assistant Professor in the Department of Biomedical Engineering at Cornell University, and a member of the graduate faculty in Mechanical and Aerospace Engineering and the Cornell Nanobiotechnology Center. She obtained undergraduate degrees in chemical engineering and biology at MIT. While there, she was awarded the Randolph G. Wei Award for "research at the interface of the life sciences and engineering." As a graduate student at the University of Pennsylvania in the Department of Bioengineering, she received a Whitaker Foundation Graduate Fellowship to support her thesis work on endothelial cell mechanobiology. She then completed postdoctoral training as an Individual NIH NRSA postdoctoral fellow in the Cardiovascular Research Institute at the University of Rochester. Dr. Reinhart-King's current research interests are in the areas of cell-biomaterial interactions, cell mechanics, and vascular cell signaling. Her lab uses a multidisciplinary approach, drawing from cell and molecular biology, biophysics, and biomechanics to quantitatively examine the mechanisms of tissue formation and disease progression. Her lab is funded by the American Heart Association, the National Institutes of Health, and the American Federation of Aging Research, and her recent independent work received a Silver Medal at the 6th World Congress on Biomechanics. She has also received the 2010 Sonny Yau '72 Excellence in Teaching Award, the highest award for teaching in College of Engineering.

*BMES established this award in 2000 to honor Rita M. Schaffer, former BMES Executive Director. Rita's gift of her estate, along with contributions from her family, friends, and associates, has enabled BMES to create the Rita Schaffer Young Investigator Award, which includes the Rita Schaffer Memorial Lecture.*