College of Engineering
Department of
Mechanical & Industrial Engineering

The Sidney E. Fuchs Seminar Series

3:00-4:00pm, Friday, September 14th, 2018
1200 Patrick F Taylor Hall

A Microfluidic Toolbox for Biomedical Applications

by Bruce K. Gale*

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Complete lab-on-a chip or micro total analysis systems (μ-TAS) require a wide variety of microfluidic components for the completion of complex and challenging medical and biological assays. These components fall into 3 broad categories: sample preparation, sample separation or analysis, and detection. All three areas must be well developed for a complete system. Unfortunately, the challenges for integrating all of the various components can be daunting, especially when multiple physical processes are required, such as: fluidics, electronics, optics, chemistry, and biology. To minimize the challenge, simple solutions that combine processes into one structure must be developed. This presentation will focus on how simple microfluidic platforms can be used to solve complex problems by combining a series of simple, yet powerful, processes. As part of this work, each area of a lab-on-a-chip system will be explored for how component demands can be reduced and how simple techniques can be used to combine functions into one structure. Finally, a discussion of how to multiplex these technologies in highly parallel ways will be provided. The presentation will explore a few of our recently developed technologies in particular: human sperm trapping and sorting, pathogen detection, and microarray platforms for protein and DNA analysis using both SPR and electrochemical detection. A few of our recent medical device projects will also be highlighted, including a contact lens based fuel cell, a vascular coupling device, and a nerve regeneration device.

* **Bruce K. Gale**, received his undergraduate degree in Mechanical Engineering from Brigham Young University in 1995 and his PhD in Bioengineering from the University of Utah in 2000. He was an assistant professor of Biomedical Engineering at Louisiana Tech University before returning to the University of Utah in 2001 where he is now a professor of Mechanical Engineering. He started as Chair of Mechanical Engineering in July 2018. He is currently Director of both the Utah State Center of Excellence for Biomedical Microfluidics and the College of Engineering Nanofabrication Facility. He is also Director of Research at Carterra, a multiplexed instrument development company focused on protein characterization in the pharmaceutical industry that was spun out of his lab in 2005. He has four additional recent startups where he serves as chief scientist: Espira, which focuses on pathogen detection and exosome separations; Nanonc, which focuses on reproductive medicine applications of microfluidics; wFluidx, which focuses on genotyping zebrafish embryos; and Microsurgical Innovations, which focuses on miniature medical devices. He has been working in the area of microfluidics, nanotechnology, medical devices, and micro-total-analysis systems (μ-TAS) for more than 20 years. His primary interests include lab-on-a chip devices that require a variety of microfluidic components for the completion of complex and challenging medical and biological assays. Specifically, he is working to develop a microfluidic toolbox for the rapid design, simulation, and fabrication of devices with medical and biological applications. The ultimate goal is to develop platforms for personalized medicine, which should allow medical treatments to be customized to the needs of individual patients. He also has expertise in nanoscale patterning of proteins and sensors, nanoparticle characterization, miniature medical devices, and nanofabrication techniques.