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ELECTRICAL & COMPUTER ENGINEERING
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S E M I N A R

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From Organ-on-a-Chip to Bioenergy Solutions: Impact of Microfluidics and Lab-on-a-Chip Systems

by

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Abstract: Microfluidics, a technology that can accurately control extremely small amount of liquid samples, together with various micro/nano fabrication technologies, enable the concept of lab-on-a-chip systems. Our lab is interested in solving grand challenge problems in the broad area of health and energy through the use of micro/nano systems technology. Three of our research themes will be presented; systems that allow unique control over the cellular microenvironment to realize microphysiological systems (organ-on-a-chip), systems that enable single-cell resolution whole cell analysis, and systems that allow high-throughput analysis of microalgae as a source of next-generation transportation fuel production. In the first example, microsystem platforms that can be used as developmental neurobiology models of the central nervous system (CNS), especially for mechanistic studies of myelination in the CNS, will be introduced. These systems allow co-culture of two different cell types such as neuron and glia in specific spatial patterns, allow 3D aggregate culture for better physiological relevance, and allow quantitative analysis of axon growth and regeneration. In the second example, microfluidic systems that allow single-cell resolution analysis of metastatic cancer cells through impedance spectroscopy and vibro-acoustic measurement will be presented. Finally, a high-throughput microfluidic system as a photosynthetic organism screening/analyses platform that is currently being used to identify and define metabolic processes and genetic constraints that significantly enhance oil production and growth of microalgae will be introduced. We believe that microfluidic and lab-on-a-chip platforms can dramatically accelerate research and development in the broad area of life science disciplines.

Dr. Arum Han is an Associate Professor in the Department of Electrical and Computer Engineering and also in the Department of Biomedical Engineering at Texas A&M University (USA). He joined Texas A&M University in 2005 as an Assistant Professor. He is also a faculty of Texas A&M Health Science Center and the Texas A&M Institute for Neuroscience. He received his Ph. D in electrical engineering from the Georgia Institute of Technology in 2005, his M.S. from the University of Cincinnati in 2000, and his B.S. from the Seoul National University in 1997, all in electrical engineering.

His research interests are in solving grand challenge problems in the broad areas of health and energy through the use of micro/nano systems technologies. He has co-authored more than 80 peer-reviewed publications and has received funding from the Bill and Melinda Gates Foundation, National Institutes of Health (NIH), National Science Foundation (NSF), Defense Threat Reduction Agency (DTRA), United States Department of Agriculture (USDA), U.S. Army Corp of Engineers, Qatar National Research Foundation (QNRF), and several other international sponsors and private companies. He serves as the editorial board member of the journal PLoS ONE. He is a Texas A&M Engineering Experiment Station (TEES) Fellow, Eugene Webb Faculty Fellow of Texas A&M University, recipient of the Engineering Genesis Award for Multidisciplinary Research from Texas A&M University, and recipient of the E. D. Brockett Professorship Award.