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Development of an In-Vitro Blood-Brain-Barrier Model For Biomedical Applications

By Prof. Hanseup Kim, University of Utah

ABSTRACT: The blood-brain barrier (BBB), a unique selective barrier for the central nervous system (CNS), hinders the passage of most compounds into the brain and complicates the development of brain-targeting pharmaceutical compounds. The development of an in-vitro BBB model can provide useful insights into its role in CNS disease progression and drug delivery. Conventional static transwell models lack fluidic shear stress, while recent dynamic *in vitro* BBB models lack a thin dual cell layer interface. To address such issues, we have developed a microfluidic blood-brain barrier (μBBB) that closely mimics the *in vivo* BBB with a dynamic environment and a comparatively thin culture membrane (10μm) by combining cell culture into microfluidic lab-on-chip technology. This presentation describes the development of a microfluidic BBB model allowing the study of BBB properties in relation to various chemical compounds by enabling tunable wall shear stress (WSS) via dynamic fluid flow, cell-cell interaction through a thin co-culture membrane, time-dependent delivery of test compounds, and integration of sensors into the system, resulting in significant reduction of reagents and cells required and shorter cell seeding time. The developed *in vitro* microfluidic BBB model provides distinct advantages for monitoring and modulating barrier functions and prediction of compound permeability, and could provide an innovative platform to study mechanisms and pathology of barrier function as well as to assess novel pharmaceuticals early in development.

BIOGRAPHY: Hanseup Kim is an USTAR Assistant Professor of Electrical and Computer Engineering, Mechanical Engineering, and BioEngineering at the University of Utah. He received his BS degree in Electrical Engineering from Seoul National University in 1997, and his MS and Ph.D. degrees in Electrical Engineering from Michigan in 2002 and 2006, respectively. Between 2006 and 2009, he was a post-doctoral research fellow at the Center for Wireless Integrated MicroSystems (WIMS) in the University of Michigan. His current research interests focus on the development of integrated micro/nano systems for environmental monitoring and healthcare research by combining micro/nanofabrication techniques, micro actuators, microfluidics for "compressible" gases, in-vitro cell culture models, and inertial/chemical sensors. Prof. Kim is a recipient of both the prestigious NSF CAREER Award 2012 and the DARPA Young Faculty Award in 2011. He received the Best Paper Awards from the international conferences of Commercialization of Micro and Nano systems (COMS) 2008 and 2014, respectively, and the 38th International Design Automation Conference (DAC) in 2001.

EVENT DETAILS

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