



CEE Seminar Speaker **SIYANG ZHENG**

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MICRO/NANO ENGINEERING-ENABLED LUNG-ALVEOLI-ON-A-CHIP FOR STUDIES ON LUNG HEALTH

The human lung alveolar microenvironment is critical for lung development, regeneration, and the pathogenesis of diseases such as respiratory infections, pulmonary fibrosis, lung cancer, asthma, and COPD. However, existing in vitro models inadequately replicate the physiological barriers and mechanical dynamics of the lung. Here, we present a recently developed lung alveoli-on-a-chip system, featuring a highly porous (up to 40%) alveolus-shaped polymer membrane integrated into a device that closely replicates the structural, mechanical, and transport properties of the human alveolar-capillary interface under air-liquid interface culture and simulated breathing motion. This engineered membrane enables efficient gas and nanoparticle diffusion while supporting long-term co-culture of primary epithelial and endothelial cells with sustained viability and barrier integrity. Using this platform, we systematically evaluated the toxicity of nanoscale coal dusts, assessing their effects on cell viability, inflammation, epithelial-endothelial barrier disruption, and DNA damage. The device also serves as a platform for therapeutic screening. Our findings demonstrate the utility of this advanced lung-on-chip system as a physiologically relevant model for mechanistic studies of lung biology and a preclinical tool for evaluating inhaled environmental hazards and therapeutic interventions.

BIOGRAPHY

Dr. Siyang Zheng is currently a tenured Professor at Carnegie Mellon University (CMU) in Departments of Biomedical Engineering and Electrical and Computer Engineering. Prior to his appointment at CMU, he was an Associate Professor of Biomedical Engineering at The Pennsylvania State University at University Park. He graduated from Department of Biological Science and Biotechnology at Tsinghua University, and later received his Ph.D. in Electrical Engineering from California Institute of technology. He has published over 70 peer-reviewed journal papers. He also holds more than 15 patents and patent applications. Among other honors, he is the recipient of the NIH Director's New Innovator Award and the American Cancer Society's Research Scholar Award. Dr. Siyang Zheng's main research theme is to develop micro/nano technologies to enable critical biomedical applications and provide next-generation healthcare solutions. The research lies at the interface of material, device, and biomedicine. Presently, Dr. Siyang Zheng's endeavors span several exciting areas, including pioneering liquid biopsy technologies that leverage extracellular vesicles found in patient plasma samples, exploring the use of metal-organic framework nanoparticles for targeted delivery of therapeutic agents, innovating single-cell sequencing technology to unlock insights at the cellular level, and developing transplantable organ-on-a-chip platforms.