THE DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING SPEAKER SERIES

PRESENTS

Light-controlled cellular Surgery

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LECTURE ABSTRACT

Cell membrane is a soft, elastic, and fragile structure without solid mechanical support. Precision surgery on a cell membrane is an extreme challenge. Enabling technologies for precision cutting and transferring large-sized cargo into mammalian cells are needed to advance key applications in cell engineering. However, a reliable methodology for introducing large-sized cargo into mammalian cells at high throughput has not existed. Here, we report a massively parallel light-controlled platform for high-throughput, high precision cell surgery, and delivery of large cargo directly into mammalian cells. Cargo up to a micron in size or more can be delivered into 100,000 cells on the platform in a minute. The delivery platform is a compact chip on which hundreds of thousands of micron-sized cavitation bubbles explode in response to laser pulse illumination. High-speed fluid flows near cavitation bubbles disrupt contacting cell membranes with precision, resulting in micron-sized transient membrane pores. Pressured flow provides an active driving force to speed slow diffusing, large-sized cargo through these pores before they reseal. We have reproducibly delivered large cargo including micron-sized bacteria, enzymes, antibodies, and functional nanoparticles into a variety of cell lines, including three different primary cells, with high efficiency and high cell viability. Massively parallel and nearly simultaneous delivery of cargo into cells under the same physiological conditions enables reliable statistical measurements of cargo interactions with cells over time.

SPEAKER BIOSKETCH

Dr. Pei-Yu Chiou received his Ph.D. degree in the Electrical Engineering and Computer Sciences Department from the University of California at Berkeley in 2005. He received his M.S. degree in the Electrical Engineering Department from UCLA and B.S. degree in the Mechanical Engineering Department from National Taiwan University in 1998. He was an assistant professor in the Mechanical and Aerospace Engineering Department at the University of California at Los Angeles (UCLA) between 2006~2011, associate professor between 2011~2015, and full professor since then. He is also a full professor in the Bioengineering Department in UCLA. His research interests focus on optofluidics, biophotonics, and flexible electronic and mechanical devices. He received the NSF CAREER award in 2008, UCLA MAE Teaching Award in 2014, JALA TOP TEN innovation award in 2015. He is a fellow of American Institute for Medical and Biological Engineering (AIMBE), a fellow of The Royal Society of Chemistry (RSC).