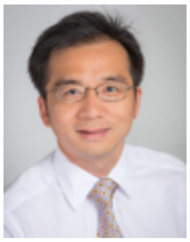
Acoustofluidics: merging acoustics and microfluidics for biomedical applications



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LECTURE ABSTRACT

The past two decades have witnessed an explosion in lab-on-a-chip research with applications in biology, chemistry, and medicine. The continuous fusion of novel properties of physics into microfluidic environments has enabled the rapid development of this field. Recently, a new lab-on-a-chip frontier has emerged, joining acoustics with microfluidics, termed acoustofluidics. Here we summarize our recent progress in this exciting field and show the depth and breadth of acoustofluidic tools for biomedical applications through many unique examples, from exosome separation to cell-cell communications to 3D bioprinting, from circulating tumor cell isolation and detection to ultra-high-throughput blood cell separation for therapeutics, from high-precision micro-flow cytometry to portable yet powerful fluid manipulation systems. These acoustofluidic technologies are capable of delivering high-precision, high-throughput, and high-efficiency cell/particle/fluid manipulation in a simple, inexpensive, cell-phone-sized device. More importantly, the acoustic power intensity and frequency used in these acoustofluidic devices are in a similar range as those used in ultrasonic imaging, which has proven to be extremely safe for health monitoring during various stages of pregnancy. As a result, these methods are extremely biocompatible; *i.e.*, cells and other biospecimen can maintain their natural states without any adverse effects from the acoustic manipulation process. With these unique advantages, acoustofluidic technologies meet a crucial need for highly accurate and amenable disease diagnosis (*e.g.*, early cancer detection and monitoring of prenatal health) as well as effective therapy (*e.g.*, transfusion and immunotherapy).

SPEAKER BIOSKETCH

Tony Jun Huang is the William Bevan Distinguished Professor of Mechanical Engineering and Materials Science at Duke University. Previously he was a professor and the Huck Distinguished Chair in Bioengineering Science and Mechanics at The Pennsylvania State University. He received his Ph.D. degree in Mechanical and Aerospace Engineering from the University of California, Los Angeles (UCLA) in 2005. His research interests are in the fields of acoustofluidics, optofluidics, and micro/nano systems for biomedical diagnostics and therapeutics. He has authored/co-authored over 220 peer-reviewed journal publications in these fields. His journal articles have been cited more than 16,000 times, as documented at Google Scholar (h-index: 71). He also has 26 issued or pending patents. He was elected a fellow of the following six professional societies: the American Association for the Advancement of Science (AAAS), the American Institute for Medical and Biological Engineering (AIMBE), the American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronics Engineers (IEEE), the Institute of Physics (IoP), and the Royal Society of Chemistry (RSC). Huang's research has gained international recognition through numerous prestigious awards and honors including a 2010 National Institutes of Health (NIH) Director's New Innovator Award, a 2012 Outstanding Young Manufacturing Engineer Award from the Society for Manufacturing Engineering, a 2013 American Asthma Foundation (AAF) Scholar Award, JALA Top Ten Breakthroughs of the Year Award in 2011, 2013, and 2016, the 2014 IEEE Sensors Council Technical Achievement Award from the Institute of Electrical and Electronics Engineers (IEEE), the 2017 Analytical Chemistry Young Innovator Award from the American Chemical Society (ACS), the 2019 Van Mow Medal from the American Society of Mechanical Engineers (ASME), and the 2019 Technical Achievement Award from the IEEE Engineering in Medicine and Biology Society (EMBS).

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