Applications of High-Frequency Ultrasonics in Microfluids and Microactuation

Prof. James Friend
MicroNanophysics Research Laboratory
Monash University
Melbourne Centre for Nanofabrication
Melbourne, Australia

Abstract: The transmission of acoustic waves through materials and across interfacial discontinuities is a centuries-old area of research. A rather curious application of ultrasonic acoustic radiation—actuation of fluids and particles within them—has renewed interest in this area and exposed phenomena that are not explained by previous theories once viewed as canon. During the talk applications of these phenomena will be proffered, including fingernail-sized microdevices to atomize sessile droplets for drug encapsulation, pulmonary drug delivery and nanoparticle formulation; devices for droplet jetting and manipulation; a device for fluid pumping and particle segregation in closed microfluidics structures; devices for swimming and catheter navigation in neurosurgery, and a device to enable micro and nanoparticle concentration and separation in a sessile droplet in a matter of seconds. Along the way, the underlying physical phenomena will be touched upon, and the potential future of this area will bring the presentation to a close.

James Friend is a Professor in the Department of Mechanical and Aerospace Engineering at Monash University, Melbourne Australia, and has interests in the physics and applications of small technologies. He is the associate editor of Biomicrofluidics, is a member of the IEEE Nanotechnology for Biology and Ultrasonics Technical Committees, is on the advisory board of the Lifeboat Foundation for safe uses of nanotechnology. From 2001 to 2004, Dr. Friend was an assistant professor at the Precision and Intelligence Laboratory, Tokyo Institute of Technology. He joined Monash University in late 2004, and co-founded and co-directs the $7.5 million MicroNanophysics Research Laboratory at the Melbourne Centre for Nanofabrication with Dr Leslie Yeo; the lab currently has a staff of three academics, five post-doctorates and eight PhD students. He has over one hundred peer-reviewed publications, with five book chapters, seventy-six peer-reviewed journal papers, and twenty-one patents and patent applications in progress. He received excellence in research, teaching and early career researcher awards from the Monash Faculty of Engineering in 2010, 2006 and 2008, respectively, a Future Leader award from the Davos Future Summit in Sydney in 2008, and was awarded membership in the Top 10 emerging scientific leaders of Australia by Microsoft and The Australian newspaper in 2009.