Title: Microstructures to shape Acoustic Fields and Produce Complex Fluidic Flows
Interactions between Fluids, Ultrasound & Phononic Structures

Microfluidics and Lab-Chip technologies are synonymous with the movement of fluids on or around microstructured surfaces, including channels. One method to achieve this, that has gained popularity in both academic and industrial applications has been the use of mechanical forces from acoustic actuation of the fluid, leading to e.g. streaming. To better control the nature of the acoustic field when using surface acoustic waves (SAWs), we have introduced the concept of using frequency dependent periodic arrays known as phononic crystals. In doing so, we have enabled waveguides, reflectors, bandgaps and lenses, that shape the ultrasonic field and create new fluid flows. These different functions can be used to create a "tool-box" of different applications. Just as in electronics, where discrete functional components are integrated to create circuits, so we propose to combine different phononic lattices into Lab-on-a-Chip, to create fluidic microcircuits. A number of “real-world” examples are used to illustrate these ideas including medical diagnosis of infectious diseases, the enrichment of cells from clinical samples; and in drug delivery, where the control of the size distribution of droplets during nebulization can be achieved by restricting the fluid in a phononic crystal.