



Nano-acoustics for Intravascular Ultrasound Imaging and Therapy

Xiaoning Jiang
North Carolina State University

Acoustics associated nanomaterials, nanostructures, nanofabrication and devices (nanoacoustics) has been actively investigated over the past two decades for a broad range of biomedical imaging and therapy applications because of its unique performance enabled by nanotechnology. On the other hand, cardiovascular disease (CVD) remains a major health concern and the search for more effective diagnosis and treatment techniques has been of a great interest. In this talk, micro/nanotechnology enabled small aperture transducers were designed, fabricated and tested for advanced intravascular ultrasound imaging (IVUS) and intravenous sonothrombolysis. In specific, we investigated high frequency (40-60 MHz) micromachined piezoelectric composite transducers and arrays with broad bandwidth (-6 dB fraction bandwidth \sim 80%) for intravascular ultrasound (IVUS) imaging. Dual frequency transducers and arrays (6.5 MHz/30 MHz, 3 MHz/30 MHz) were also successfully demonstrated for microbubble enhanced intravascular superharmonic imaging (or acoustic angiography) toward detection of plaque vulnerability. For the case of intravascular thrombolysis, small aperture (diameter <2 mm) sub-MHz forward-looking and vortex transducers were successfully developed with sufficient peak-negative-pressure for sonothrombolysis. Significantly enhanced thrombolysis rate was observed by using microbubbles and nanodroplets in in-vitro tests. These new findings suggest that nanoacoustics associated small aperture ultrasound transducers and micro/nano-contrast agents are increasingly important in advancing intravascular ultrasound imaging, intravenous therapy, minimal invasive diagnosis and therapy, and image guided drug delivery and surgery.