Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Photoacoustic shock wave emission and cavitation from structured optical fiber tips MILAD MOHAMMADZADEH, SILVESTRE ROBERTO GONZALEZ AVILA, Nanyang Technological University, YIN CHI WAN, XINCAI WANG, HONGYU ZHENG, Singapore Institute of Manufacturing Technology, CLAUS-DIETER OHL, Nanyang Technological University — Fiber optics are used in medicine to deliver laser pulses for microsurgery. Upon absorption of a high-power laser pulse, a thermoelastic wave is emitted from the fiber tip. If a flat cleaved fiber is used, the photoacoustic field comprises a planar compressive shock wave and a tensile diffraction wave from the tip edge. Here we demonstrate that by modifying the geometry of a fiber tip, multiple shock waves can be generated from a single laser pulse. Flat cleaved fibers generate tension only along the fiber axis and with one compression-tension cycle from a laser pulse; however, structured fiber tips cause significant tension both along and off-axis, and generate multiple pressure cycles from a single laser pulse. Fast flash photography reveals that diffraction waves from the edges of the tip structures overlap and generate enough tension to form cavitation clouds. We numerically solve the linear wave equation to model the acoustic transients of structured fiber tips and achieve good agreement with pressure measurements from a fiber optic hydrophone. Multiple shock wave emission from a single laser pulse introduces structured fiber tips as a candidate to deliver histotripsy effects via a surgical catheter for micro-scale ablation of soft tissue.

Milad Mohammadzadeh
Nanyang Technological University

Date submitted: 28 Jul 2015 Electronic form version 1.4