**Controlling cavitation bubble lifetimes on the nanosecond scale:  
Rayleigh wave induced cavitation**

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**Abstract**

The maximum size and lifetime of an acoustically nucleated cavitation bubble is inversely proportional to the driving frequency and has achieved a limit of about 10 MHz. Smaller cavitation bubbles that are critical to microscopic applications require shorter lifetimes which correspond to higher oscillation frequencies. Here we demonstrate that acoustic cavitation in the 100 MHz range and beyond can be achieved through wave propagation in a solid rather than in a liquid. The cavitation bubble is nucleated at a nano-sized fracture on a glass substrate and its expansion is driven by a leaky Rayleigh wave, while the inertial collapse is induced by a trailing shock wave. As both waves travel at different velocities, the time interval between these two events is a function of the distance to the source. In this way, we experimentally demonstrate control of the lifetime of the bubbles in a range between 6 and 80 ns, corresponding to oscillation frequencies between 13 and 166 MHz. Our results agree with finite volume fluid-structure interaction simulations.