Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

An Experimental and Theoretical Investigation of Ultrasound Transmission in Bubbly PDMS Phononic Crystals[1] CALEB CHRISTIANSON, University of Kansas, SAIKAT MUKHOPADHYAY, WOLFGANG SACHSE, DEREK STEWART, Cornell University — Phononic crystals are two- and three-dimensional structures with a periodic arrangement of two or more materials with different acoustic properties. Depending on the size, structure, and characteristics of the constituent materials, metamaterials with interesting acoustic properties can be formed. These crystals can be used to control the transmission of sound at selected frequencies, focus sound, or serve as waveguides. In this talk, we will focus on the transmission of ultrasonic waves through polydimethylsiloxane (PDMS) films with entrapped air bubbles. Two different theoretical models were used to predict ultrasonic transmission through air-PDMS crystals: (1) a simple scattering model for a series of partially reflective thin films and (2) the code MULTEL, which calculates the transmission using multiple scattering theory. A fabrication process was also developed to stack layers of the crystals with unprecedented alignment. We measured the ultrasonic transmission through the films using the ultrasonic through-transmission mode in a water bath and found an excellent agreement between the measured and calculated transmission. Additionally, we used these models to predict the performance of new phononic structures by scanning a large parameter space and showed how ultrasonic transmission through PDMS layers can be engineered by varying the dimensions, separation, and arrangement of air bubbles.

[1]This work was supported by the National Science Foundation.

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Date submitted: 15 Nov 2013 Electronic form version 1.4