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Engineering Phononic Bandgap Shield for High-Q Silicon Nitride Membrane Resonators K. CICAK, NIST - Boulder, P.-L. YU, N.S. KAMPEL, JILA and University of Colorado, Boulder, Y. TSATURYAN, JILA, T.P. PURDY, JILA and University of Colorado, Boulder, R.W. SIMMONDS, NIST - Boulder, C.A. REGAL, JILA and University of Colorado, Boulder — High-stress Si_3N_4 membrane mechanical resonators exhibit ultrahigh Q-frequency products. These millimeter-sized, macroscopic objects should exhibit quantum properties and can be integrated into opto-mechanical, electro-mechanical, and even hybrid electro-opto-mechanical systems. They represent an enabling technology for mediating quantum information transfer between vastly different frequency domains. Experimentally achieving high Q-factors with these membranes is hindered by coupling to support structures providing a path for energy loss to the environment (i.e. clamping or support losses). We have microfabricated membranes embedded into phononic crystals etched into the silicon support structure. In order to realize acoustic isolation and shielding from the environment, these structures are engineered to have phononic bandgaps $\sim$1 MHz wide centered around membrane mode frequencies in the MHz range. In this talk, we will discuss device design (aided by finite-element simulation) and fabrication.

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