Acoustic phonon manipulation in GaAs/AlGaAs electromechanical systems

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The use of compound semiconductor heterostructures allows us to fabricate micro/nanoelectromechanical resonators with novel functionalities. The material systems are piezoelectric and highly functional micro/nanoelectromechanical devices can be integrated with electronic device architectures. We have been studying isolated electromechanical parametric resonators, where the mechanical oscillation can be electrically and dynamically controlled [1]. We apply this electromechanical system to the fabrication of acoustic phononic crystal waveguides. In contrast to an isolated mechanical resonator, a phononic crystal waveguide enables electrical and dynamical control of travelling mechanical waves by constructing periodically coupled array of resonators in arbitrary geometry. In this talk, we will present our recent experimental results using this novel class of electromechanical devices, especially on dynamic phonon propagation control [2], all mechanical random memory operation [3], and the demonstration of on-chip phononic time lens [4].

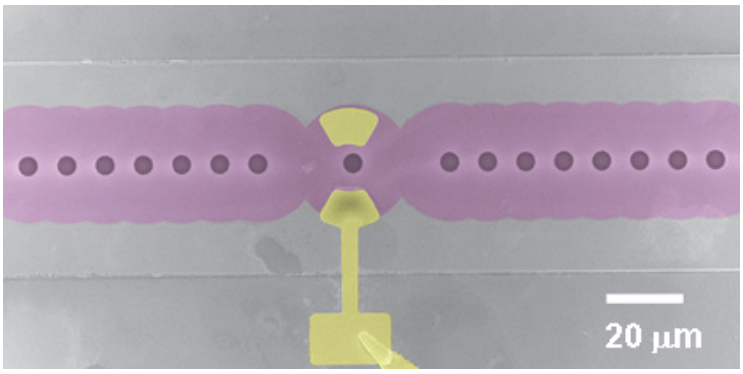

Fig. 1: False-color SEM image of a phononic crystal waveguide embedding an electromechanical resonator. The purple area is suspended and consists of an AlGaAs/n-GaAs heterostructure, where the acoustic vibration is propagating. The yellow areas are Shottky electrodes for the electromechanical control of the wave propagation. The waveguide is 1-mm long (not shown).

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