Tunable Metasurface Design for Acoustic Wave Control

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ABSTRACT

Acoustic metasurfaces have been studied intensively in the past few years because of their strong and robust capability to manipulate waves. Although some metasurfaces have designed to present excellent performance in acoustic wave control with subwavelength thickness, they are typically studied and built for fixed applications. This paper provides a convenient tunable metasurface design with coupled Helmholtz and Fabry-Perot resonances. Helmholtz resonance harnesses the phase shift and Fabry-Perot resonance insures impedance matching for high sound transmission. The hybrid units are designed by the fixed size and adjustable sliders to make a controllable metasurface. Moving sliders in the design allow full phase shift with high transmission ratio. The position of the slider in the design allows changing the resonance characteristics, which results in the control of the system without altering the overall size of the unit. The design has the advantage of allowing the entire structure to be made of a single material. Numerical and experimental examples indicate that the designed metasurface can be used for tunable wave front redirection, focusing with varying wavelengths and sound source illusion. This design could be a superb option when there is a need for tunable acoustic wave modulation.