Metamaterial-based Enhancement of Elastic Wave Energy Harvesting

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ABSTRACT

Enhancement of metamaterial-based energy harvesting will be presented from design, analysis towards experimental demonstration. Metamaterials, artificially engineered materials, exhibit unique properties including bandgap and negative refractive index and thus enable us to manipulate mechanical wave propagations. In order to amplify input mechanical wave energy into energy harvesting systems, metamaterials can be utilized to guide and localize acoustic and elastic waves towards the desired position for harvesting. Recently, several research efforts on metamaterial-based enhancement of energy harvesting have been reported, but mostly based on intuitive design or with little experimental support. We propose several metamaterial-based energy harvesting systems including phononic crystals with defect and acoustic metamaterials with local resonances. Systematic design through geometric and bandgap optimization process is performed and followed by experimental demonstration. Drastic enhancement of energy harvesting performance via metamaterials is demonstrated and thoroughly investigated both analytically and experimentally.

KEYWORDS: metamaterials, energy harvesting, elastic waves, piezoelectricit