
Magnetically Tunable Defective Phononic Crystal Microbeams: Wave Propagation and Energy Harvesting Characteristics

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Abstract

This study explores the wave propagation and energy harvesting capabilities of magnetically tunable defective phononic crystal (PnC) microbeams, incorporating microstructure effects. A theoretical model for a sandwich-structured PnC beam is established using modified couple stress theory. Parametric analyses are performed to investigate the impact of microstructure, external magnetic fields, and defect lengths on bandgap formation and defect band characteristics. Numerical simulations demonstrate the influence of defect mode shapes on elastic wave localization, offering insights for optimizing energy harvesting efficiency. Transmission curves under varying magnetic field intensities and defect segment lengths are evaluated using the spectral element method, alongside the voltage output of a piezoelectric layer attached to the defect region. The findings highlight the potential of external magnetic fields for non-contact tuning of bandgap and defect band frequencies, providing a framework for enhancing energy harvesting devices based on PnC defect structures.

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