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PROCEEDINGS

Transmission Characteristics in Solid-Liquid Phase changing Metamaterials

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ABSTRACT

Acoustic metamaterials have garnered significant attention in recent years due to their potential to manipulate sound waves and the ability to dynamically adjust the bandgap of such materials is particularly crucial.

This work investigates the influence mechanisms of solid-liquid phase change processes on the performance of metamaterials, which is a significant research focus in the field of acoustic metamaterials. The primary objective is to explore the mechanisms governing the controllable shifting of bandgaps through phase change processes. By utilizing solid-liquid phase change materials as scattering bodies, numerical methods were employed to calculate the band structure and mode shapes of the unit cells under different morphologies of the scattering bodies. A three-dimensional printing technology was utilized to fabricate a periodic structure. Then we test the transmission properties of metamaterial structures in different phases of solid-liquid phase transformation driven by heating, and the experimental results were in good agreement with the corresponding numerical calculation. The results indicate that as the phase change process progresses, the solid-liquid ratio of the scattering bodies continuously decreases, leading to a gradual shift of the bandgap towards lower frequencies, ultimately reaching a stable state. The center frequency of the bandgap shifts from approximately 4000 Hz to 1500 Hz during the phase change process, demonstrating the feasibility of achieving large-scale controllable bandgap shifting through the solid-liquid phase change effect. These findings provide a research direction for the vibration isolation control of metamaterials.

KEYWORDS

Acoustic metamaterials; phase change material; transmission characteristics

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