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Tunable phononic crystals via instability-induced interfacial wrinkling

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ABSTRACT

We present a method to control wave propagation in highly deformable layered media by utilizing elastic instability-induced wrinkling of interfacial layers. The onset of a wrinkling instability in initially straight interfacial layers occurs when a critical compressive strain or stress is achieved [1]. Further compression beyond the critical strain leads to an increase in the wrinkle amplitude of the interfacial layer. This, in turn, gives rise to the formation of a system of periodic scatterers, which reflect and interfere with wave propagation. We demonstrate that the topology of wrinkling interfacial layers can be controlled by deformation and used to produce band-gaps in wave propagation and, hence, to selectively filter frequencies [2]. Remarkably, the mechanism of frequency filtering is effective even for composites with similar or identical densities, such as polymer–polymer composites. Because the microstructure change is reversible, the mechanism can be used for tuning and controlling wave propagation by deformation.

REFERENCES

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