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Band Structure Properties of Elastic Waves Propagating in the Nanoscaled Nearly Periodic Layered Phononic Crystals

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Abstract：The localization factor is used to describe the band structures for P wave propagating normally in the nanoscaled nearly periodic layered phononic crystals. The localization factor is calculated by the transfer matrix method based on the nonlocal elastic continuum theory. Three kinds of nearly periodic arrangements are concerned, i.e., random disorder, quasi-periodicity and defects. The influences of randomly disordered degree of the sub-layer's thickness and mass density, the arrangement of quasi-periodicity and the location of defect on the band structures and cut-off frequency are analyzed in detail.

Keywords：Elastic wave; Nanoscale; Nearly periodic; Phononic crystal

1 Introduction

Phononic crystals (PNCs) refer to the artificial periodic structures whose most essential characteristic is their elastic band gaps [1]. Owing to the wide potential applications in sound detectors, filters, wave guides and sensors, etc., more and more researchers paid attention to elastic band gaps. Theoretically, PNCs are strictly ordered periodic systems. However, in practical cases, the random disorder, even the complete disorder, exists because of the random distributed impurity or manufacture errors. The localization phenomenon will appear because of the introduction of disorders which provides the theoretical guidance for controlling and tuning the propagation of elastic waves [2]. Furthermore, quasi-periodic or defected structures can be regarded as the periodic systems disordered in peculiar forms, which also have effects on controlling and tuning the elastic waves. These structures are commonly known as nearly periodic structures which are not in completely periodic arrangement [3].

With the rapid development of communication and biomedical engineering, the

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