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Yan-Feng Wang, Ting-Ting Wang, Jun-Wei Liang, Yue-Sheng Wang, Vincent Laude

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Channeled spectrum in the transmission of phononic crystal waveguides

Yan-Feng Wang[a,b], Ting-Ting Wang[b,c], Jun-Wei Liang[b], Yue-Sheng Wang[a,b], Vincent Laude[c]

[a] *School of Mechanical Engineering, Tianjin University, 300350 Tianjin, China*
[b] *Institute of Engineering Mechanics, Beijing Jiaotong University, 100044 Beijing, China*
[c] *Institut FEMTO-ST, Université de Franche-Comté, CNRS, F-25030 Besançon Cedex, France*

Abstract

Waveguiding in a phononic crystal (PC) can be achieved along either linear line defects or a sequence of cavities, for frequencies belonging to a complete bandgap. When waves are coupled inside a PC waveguide, modulations in the frequency transmission are generally observed, leading to the formation of a channeled spectrum. We show that the channeled spectrum results from the interference of forward and backward guided Bloch waves. We first theoretically develop a Bloch wave interference model. Then, we consider the case of linear waveguides and of coupled-resonator waveguides formed in a 2D square PC composed of water cylinders in mercury. The transmission properties of waveguides with different length and defect distribution are examined. In all cases, the observed channeled spectra are well explained by the theoretical model. This work is relevant to the design of new acoustic and elastic wave devices.

Keywords: Phononic crystal, phononic crystal waveguide, channeled spectrum

1. Introduction

As a kind of artificially periodic functional composite, phononic crystals (PCs) have attracted a lot of attention since their proposal in 1993 [1]. One unique property of PCs is to exhibit bandgaps for certain frequency ranges, where wave propagation is fully prohibited. Thus, they have direct applications to sound insulation [2, 3, 4] and vibration reduction [5, 6, 7], for

Email addresses: wangyanfeng@bjtu.edu.cn (Yan-Feng Wang), vincent.laude@femto-st.fr (Vincent Laude)