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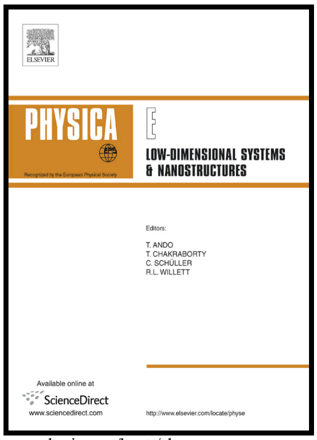

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Longitudinal waves in carbon nanotubes in the presence of transverse magnetic field and elastic medium

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Abstract

In the present paper, the coupling effect of transverse magnetic field and elastic medium on the longitudinal wave propagation along a carbon nanotube (CNT) is studied. Based on the nonlocal elasticity theory and Hamilton's principle, a unified nonlocal rod theory which takes into account the effects of small size scale, lateral inertia and radial deformation is proposed. The existing rod theories including the classic rod theory, the Rayleigh-Love theory and Rayleigh-Bishop theory for macro solids can be treated as the special cases of the present model. A two-parameter foundation model (Pasternak-type model) is used to represent the elastic medium. The influence of transverse magnetic field, Pasternak-type elastic medium and small size scale on the longitudinal wave propagation behavior of the CNT is investigated in detail. It is shown that the influences of lateral inertia and radial deformation cannot be neglected in analyzing the longitudinal wave propagation characteristics of the CNT. The results also show that the elastic medium and the transverse magnetic field will also affect the longitudinal wave dispersion behavior of the CNT significantly. The results obtained in this paper are helpful for understanding the mechanical behaviors of nanostructures embedded in an elastic medium.

Keywords: wave propagation, carbon nanotube, nonlocal elasticity, elastic medium, magnetic field.

1. Introduction

Nanostructures are well known for their outstanding mechanical, electrical, thermal, optical, and chemical properties, which are increasingly used for nanosensors, nanoelectronics and nanocomposites. In order to take full advantage of nanostructures, it is quite essential to