Transverse wave propagation in viscoelastic single-walled carbon nanotubes with surface effect based on nonlocal second-order strain gradient elasticity theory

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August 31, 2020

Abstract

Nowadays, carbon nanotubes (CNTs) have been used as one of the most promising candidates for nanodevices (or nanoelectronics) and super-strong reinforcement fibers in nanocomposites. This work aims to investigate the transverse wave propagation in viscoelastic single-walled carbon nanotubes (SWCNTs) adhered by surface material. In the context of nonlocal second-order strain gradient elasticity theory, the characteristic equation of wave motion of viscoelastic SWCNTs with surface effect is systematically formulated. The analytical expression, i.e. closed-form dispersion relation between the wave frequency (or phase velocity) and the wave number, are derived for the frequency and phase velocity of the wave motion. The size-dependent characteristic lengths, surface effects and structural damping on the properties of wave propagation are elucidated in detail.

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