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Title:Study of non-local wave properties of nanotubes with surface effects
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Abstract:In macroscopic and even microscopic structural elements, surface effects can be neglected and classical theories are sufficient. As the structural size decreases towards the nanoscale regime, the surface-to-bulk energy ratio increases and surface effects must be taken into account. In the present work, the terahertz wave dispersion characteristics of a nanotube are studied with consideration of the surface effects as well as the non-local small scale effects. Non-local elasticity theory is used to derive the general governing differential equation based on equilibrium approach to include those scale effects. Scale and surface property dependent wave characteristic equations are obtained via spectral analysis. For the present study the material properties of an anodic alumina nanotube with crystallographic of ⟨1 1 1⟩ direction are considered. The present analysis shows that the effect of surface properties (surface integrated residual stress and surface integrated modulus) on the flexural wave characteristics of anodic nanotubes are more significant. It has been found that the flexural wavenumbers with surface effects are high as compared to that without surface effects. It has also been shown that, with consideration of surface effects the flexural wavenumbers are under compressive nature. The effect of the small scale and the size of the nanotube on wave dispersion properties are also captured in the present work. 
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