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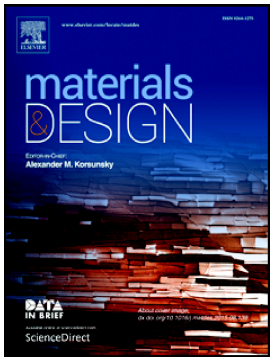

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Size dependent electro-mechanical vibration of single-walled piezoelectric nanotubes using thin shell model

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Abstract
Because of the extensive application of piezoelectric materials and nanotubes in the nanostructures, in this paper, the free vibration of piezoelectric nanotubes is investigated based on Love's cylindrical thin-shell model by using consistent couple stress theory. Due to the exclusion of size effects in the nanoscale for nanostructures by classical continuum theories, and because of the costliness of nanostructure modeling methods such as molecular dynamics and experimental methods, the consistent couple stress theory is used for piezoelectric materials in this study to investigate the effects of size on the vibration of piezoelectric nanotubes. To develop the formulation of the problem, Hamilton's principle is used, and enthalpy energy, kinetic energy and the work done by external forces are computed. Afterwards, the governing equations of the nanotube as well as the boundary conditions are determined. Finally, after developing the formulation and the equations of motion, the effect of size, electromechanical effects, and geometric effects on the nanotubes and their influence on natural frequency of piezoelectric nanotubes are investigated.

Keywords: piezoelectric, flexoelectric, consistent couple stress theory, cylindrical thin-shell model, free vibration, single-walled nanotube.