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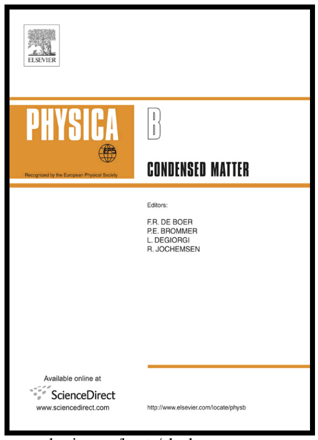

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Dynamic stability of functionally graded nanobeam based on nonlocal Timoshenko theory considering surface effects

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Abstract

Based on nonlocal Timoshenko beam theory, dynamic stability of functionally graded (FG) nanobeam under axial and thermal loading was investigated. Surface stress effects were implemented according to Gurtin-Murdoch continuum theory. Using power law distribution for FGM and von Karman geometric nonlinearity, governing equations were derived based on Hamilton's principle. The developed nonlocal models have the capability of interpreting small scale effects. Pasternak elastic medium was employed to represent the interaction of the FG nanobeam and the surrounding elastic medium. A parametric study was conducted to focus influences of the static load factor, temperature change, gradient index, nonlocal parameter, slenderness ratio, surface effect and springs constants of the elastic medium on the dynamic instability region (DIR) of the FG beam with simply-supported boundary conditions. It was found that differences between DIRs predicted by local and nonlocal beam theories are significant for beams with lower aspect ratio. Moreover, it was observed that in contrast to high temperature environments, at low temperatures, increasing the temperature change moves the origin of the DIR to higher excitation frequency zone and leads to further stability. Considering surface stress effects shifts the DIR of FG beam to higher frequency zone, also increasing the gradient index enhances the frequency of DIR.

Keywords: Dynamic stability, Surface stress effects, Nanobeam, Functionally graded materials.

Nomenclature