Nonlinear vibration analysis of the nanobeams subjected to magneto-electro-thermo loading based on a novel HSDT

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Research Article

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Abstract

In this paper, the nonlinear vibration analysis of the nanobeams subjected to magneto-electro-thermo loading based on a novel HSDT is studied. Nonlocal elasticity theory is applied to consider the small scale effect. The nonlinear equations of motion are derived using Hamilton's principle. First, a Galerkin-based numerical technique is applied to reduce the nonlinear governing equation into a set of Duffing-type time-dependent differential equations. Afterward, the analytical solutions are derived based on the method of multiple scales (MMS) and perturbation technique. All of the mechanical properties of the beam are temperature dependent. The impacts of the several variables are investigated on the nonlinear frequency ratio of the nanobeams. The results illustrate that when maximum deflection is smaller/greater than 0.2, its impact on the nonlinear frequency ratio will decrease/increase.

Full Text

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Figures

Figure 1

Nanobeam with geometrical properties

Figure 2

The variation of the shape function through the thickness for several theories

Figure 3

The impacts of size effect parameter on the nonlinear frequency ratio

Figure 4

The impacts of length-to-thickness ratio on the nonlinear frequency ratio

Figure 5

The impacts of external electric potential on the nonlinear frequency ratio

Figure 6

The impacts of external magnetic potential on the nonlinear frequency ratio