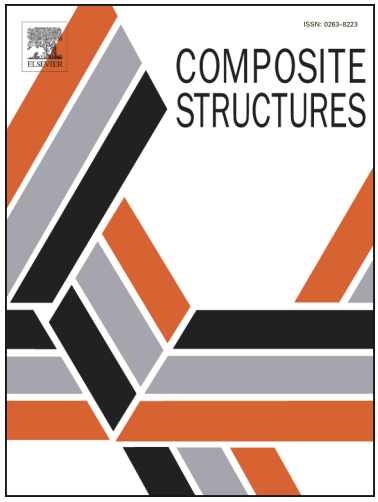

Flexoelectric effect on the bending and vibration responses of functionally graded piezoelectric nanobeams based on general modified strain gradient theory

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Flexoelectric effect on the bending and vibration responses of functionally graded piezoelectric nanobeams based on general modified strain gradient theory

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Abstract

Flexoelectric effect has been defined as the coupling between strain gradient and electric polarization, however, how to harvest remarkable polarization energy induced by flexoelectric effect is the key problem. The present work is to study the flexoelectric effect in functionally graded composite nanostructure with a volume fraction distribution function. And a more general modified strain gradient theory is used to reformulate the constitutive equations and a more scientific evaluation system is introduced to measure the electric polarization density field for static bending and free vibration behaviors of functionally graded piezoelectric nanobeams. Meanwhile, we put forward a new and simple volume fraction distribution function with two-parameters and the physical surface position for such nanobeams in which the material properties vary in the thickness direction is determined. Numerical results indicate that flexoelectric effect can observably influence the electromechanical response in functionally graded piezoelectric nanobeam at nanometer scale and the pertinent physical insights are also discussed. And the emerging functionally graded materials are significant and may help to resolve tantalizing application of flexoelectric effect on practical engineering.

Keywords: Functionally graded piezoelectric nanobeam, Modified strain gradient theory, Flexoelectric effect, Polarization density field.

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