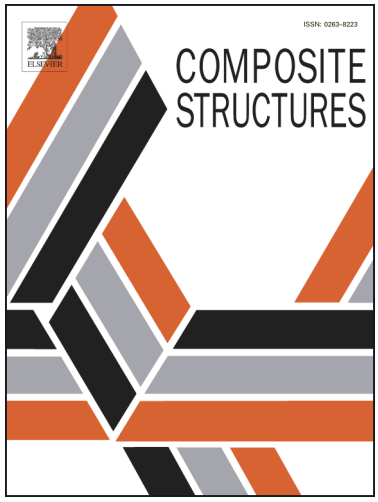

Size dependency in axial postbuckling behavior of hybrid FGM exponential shear deformable nanoshells based on the nonlocal elasticity theory

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Size dependency in axial postbuckling behavior of hybrid FGM exponential shear deformable nanoshells based on the nonlocal elasticity theory

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Abstract

The objective of this study is to examine the nonlocal nonlinear instability of functionally graded cylindrical shells at nanoscale integrated with piezoelectric nanolayers under combination of axial compressive load and lateral electric field. Eringen's nonlocal continuum elasticity is incorporated within the framework of the exponential shear deformation shell theory to consider the influence of transverse shear deformation in a refined form. Additionally, in order to eliminate the stretching-bending coupling terms, the change in the position of physical neutral plane corresponding to different volume fractions is taken into account. With the aid of the boundary layer theory of shell buckling and employing a perturbation-based solution methodology, explicit expressions for the size-dependent equilibrium paths before and after buckling point are proposed for functionally graded hybrid nanoshells with various nonlocal parameters, material property gradient indexes and subjected to different values of lateral electric field. It is indicated that the both width and depth of the snap-through phenomenon related to the axial postbuckling behavior of hybrid FGM nanoshells decrease due to the nonlocality influence.

Keywords: Hybrid laminated shell; Postbuckling; Functionally graded materials; Piezoelectricity; Nonlocal continuum theory.

1. Introduction

The interesting features of piezoelectric materials due to their intrinsic electro-mechanical interaction have led to use them as sensor and actuator bonds on the surfaces of nano-electro-mechanical systems (NEMSs) to monitor and control their mechanical responses [1]. On the other hand, because of rapid development in the material science, functionally graded materials (FGMs) as new type of composites have been used in various engineering applications [2-5]. As a result, in order to develop smart structures with adaptive characteristics, hybrid structures made of FGM coupled with bonded

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