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On the size dependent buckling of anisotropic piezoelectric cylindrical shells under combined axial compression and lateral pressure

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Abstract

Buckling of anisotropic piezoelectric cylindrical shells subjected to axial compression and lateral pressure is investigated based on the new modified couple stress theory and using the shear deformation theory with the von Kármán geometrical nonlinearity. By applying the principle of minimum potential energy, the governing equations and boundary conditions are derived. Unlike the classical continuum model, the present model is size-dependent, and the size effects are captured using the new modified couple stress theory. The critical buckling load is obtained for simply supported, clamped-simply supported and clamped piezoelectric cylindrical shells. A detailed numerical study is carried out to discuss the effects of different parameters, such as material length scale parameter, thickness ratio, length ratio, load interaction parameter and the external electric voltage on the critical buckling load. The critical buckling load is found to be significantly size-dependent, especially for large values of thickness and small values of length ratio. Besides, the influence of load interaction parameter is found to be negligible for large values of length and small values of thickness ratio.

Keywords: New modified couple stress theory, Anisotropic piezoelectric cylindrical shell, First order shear deformation theory, Buckling, Size-dependent.

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1. Introduction

Due to their special structural and functional features, nanotubes are of great significance in several areas of nanoscience. Their nanometer size, cylindrical shape, and multivalent character enable their use in nanotechnological applications, such as nano-electromechanical systems (NEMS) and biomedical sensors and medicine injection [1-7]. To obtain more precise results on the mechanical behaviors of nanotubes, developing shell models, instead of beam type elements, seems to be necessary. For example, Ansari et al. developed a size-

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