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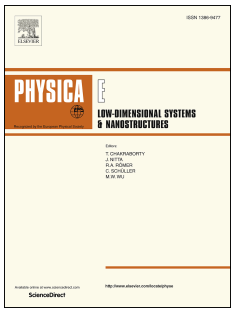

Buckling analysis of piezo-magnetoelectric nanoplates in hygrothermal environment based on a novel one variable plate theory combining with higher-order nonlocal strain gradient theory

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Buckling analysis of piezo-magnetoelectric nanoplates in hygrothermal environment based on a novel one variable plate theory combining with higher-order nonlocal strain gradient theory

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Abstract

In the present investigation, a new first-order shear deformation theory on the basis of the in-plane stability of the piezo-magnetoelectric composite nanoplate (PMEN) has been developed, and its precision has been evaluated. The composite nanoplate consisted of $BaTiO_3$-$CoFe_2O_4$, a kind of material by which coupling between piezoelectric and piezomagnetic in nanosize was established. The plate is surrounded by a motionless and stationary matrix that is embedded in a hygrothermal surround in order to keep it more stable, and to take into consideration the influences of the moisture and temperature on the plate's mechanical behavior. The governing equilibrium equations for the smart composite plate have been formulated using the higher-order nonlocal strain gradient theory within which both stress nonlocality and second strain gradient size-dependent terms are taken into account by using three independent length scale parameters. The extracted equations are solved by utilizing the analytical approaches by which numerical results are obtained with various boundary conditions. In order to evaluate the proposed theory and methods of solution, the outcomes in terms of critical buckling loads are compared with those from several available well-known references. Finally, after determining the accuracy of the results of the new plate theory, several parameters are investigated to show the influences of material properties of the ceramic composite nanoplate on the critical buckling loads.

Keywords: New first-order shear deformation theory; Piezo-magnetoelectric composite nanoplate; Higher-order nonlocal strain gradient theory; Critical buckling load

1. Introduction

The recognition of the advance of composite nanoceramics in material science and engineering applications in the last few years has been one of the most important achievements by researchers all

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