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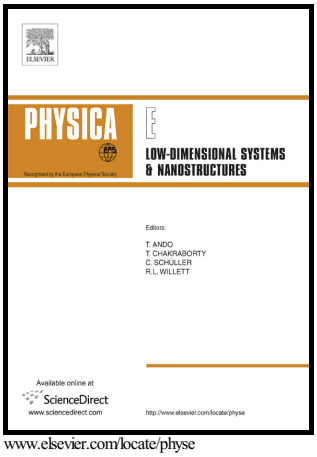

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Large deformation of uniaxially loaded slender microbeams on the basis of modified couple stress theory: Analytical solution and Galerkin-based method

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Abstract

Large deformation regime of micro-scale slender beam-like structures subjected to axially pointed loads is of high interest to nanotechnologists and applied mechanics community. Herein, size-dependent nonlinear governing equations are derived by employing modified couple stress theory. Under various boundary conditions, analytical relations between axially applied loads and deformations are presented. Additionally, a novel Galerkin-based assumed mode method (AMM) is established to solve the highly nonlinear equations. In some particular cases, the predicted results by the analytical approach are also checked with those of AMM and a reasonably good agreement is reported. Subsequently, the key role of the material length scale on the load-deformation of microbeams is discussed and the deficiencies of the classical elasticity theory in predicting such a crucial mechanical behavior are explained in some detail. The influences of slenderness ratio and thickness of the microbeam on the obtained results are also examined. The present work could be considered as a pivotal step in better realizing the postbuckling behavior of nano-/micro- electro-mechanical systems consist of microbeams.

Keywords: Microbeams; Large deformation; Postbuckling curves; Modified couple stress; Analytical solution; Assumed mode method.

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