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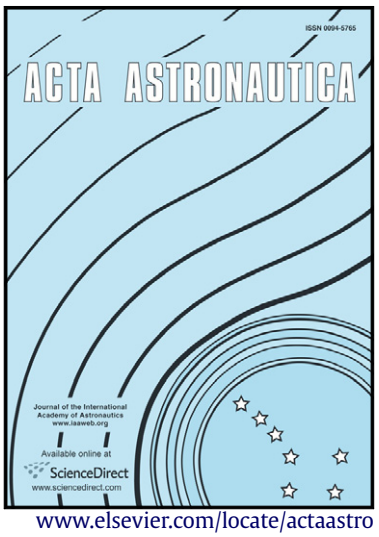

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PII: S0094-5765(14)00521-9
DOI: http://dx.doi.org/10.1016/j.actaastro.2014.12.015
Reference: AA5310

To appear in: *Acta Astronautica*

Received date: 28 August 2014
Revised date: 20 December 2014
Accepted date: 24 December 2014

Cite this article as: R. Ansari, M.A. Ashrafi, T. Pourashraf, S. Sahmani, Vibration and buckling characteristics of functionally graded nanoplates subjected to thermal loading based on surface elasticity theory, *Acta Astronautica,* http://dx.doi.org/10.1016/j.actaastro.2014.12.015

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ACCEPTED MANUSCRIPT

Vibration and buckling characteristics of functionally graded nanoplates subjected to thermal loading based on surface elasticity theory

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Abstract

The buckling and vibration responses of nanoplates made of functionally graded materials (FGMs) subjected to thermal loading are studied in prebuckling domain with considering the effect of surface stress. To accomplish this purpose, Gurtin-Murdoch elasticity theory is incorporated into the classical plate theory to develop a non-classical plate model including the surface effects. The material properties of FGM nanoplate are considered to be graded in the thickness direction on the basis of the power law function. Hamilton's principle is utilized to derive size-dependent governing differential equations of motion and associated boundary conditions. Selected numerical results are presented to indicate the importance of surface stress effect. It is revealed that in the presence of surface stress effect, the influence of material property gradient index on the critical thermal buckling load is more prominent for FGM nanoplates with lower length-to-thickness ratios. Also, by increasing the natural frequency of FGM nanoplate, the role of surface stress effect in the value of critical thermal buckling load is more prominent.

Keywords: Nanoplate; Functionally graded material; Surface stress; Vibration; Buckling.

1. Introduction

Nanoscience and nanotechnology have now been considered as one of the fastest developing and revolutionizing fields of research which has caused to create novel technologies. The structures at nanoscale such as nanowire, nanobeam, nanoplate and nanotube can be identified as the consequences of molecular manipulation that are recognized as the main parts of various nanosystems and nanodevices. Due to the light weight but high stiffness of these small scale structures, they are ideal choice to be applied in space. For instance, through reducing weight,

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