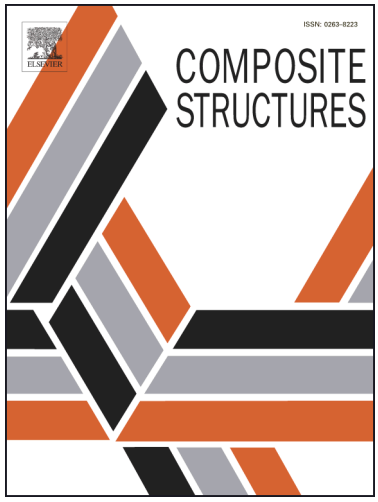

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PII: S0263-8223(16)32728-3
DOI: http://dx.doi.org/10.1016/j.compstruct.2017.03.003
Reference: COST 8321

To appear in: *Composite Structures*

Received Date: 2 December 2016
Revised Date: 18 January 2017
Accepted Date: 1 March 2017

Please cite this article as: Dehrouyeh-Semnani, A.M., Mostafaei, H., Dehrouyeh, M., Nikkhah-Bahrami, M., Thermal pre- and post-snap-through buckling of a geometrically imperfect doubly-clamped microbeam made of temperature-dependent functionally graded materials, *Composite Structures* (2017), doi: http://dx.doi.org/10.1016/j.compstruct.2017.03.003

Thermal pre- and post-snap-through buckling of a geometrically imperfect doubly-clamped microbeam made of temperature-dependent functionally graded materials

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Abstract

Owing to inappropriate fabrication processing it is likely to fabricate a geometrically imperfect functionally graded (FG) microbeam. In addition, the experimental tests show that the classical continuum theory is incapable of interpreting the mechanical behavior of microstructures when the role of size-dependency is significant. Therefore, this investigation aims to examine the influences of geometric imperfection on the nonlinear stability behavior as a prominent characteristic of microstructures for a thermally loaded doubly-clamped microbeam made of temperature-dependent FGMs by taking into account the size effect phenomenon. The geometrically nonlinear size-dependent governing equation of system is derived in the framework of modified couple stress theory in conjunction with Euler-Bernoulli beam theory and the classical rule of mixture. Based on the static form of governing equation, a closed-form solution for the nonlinear critical snap-through buckling temperature rise as well as the nonlinear thermal stability behavior of system in pre- and post-snap-through buckling domains is proposed and analytical study is then carried out by consideration of different effective parameters i.e., dimensionless imperfection amplitude, size-dependency, temperature-dependency, and power index. To verify the closed-form solution, the dynamic response of system is numerically evaluated by implementation of Galerkin scheme in conjunction with Runge-kutta finite difference method.

Keywords

Geometrically imperfect doubly-clamped microbeam; Temperature-dependent FGMs; Critical snap-through buckling temperature rise; Nonlinear size-dependent thermal stability; Modified couple stress theory.

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