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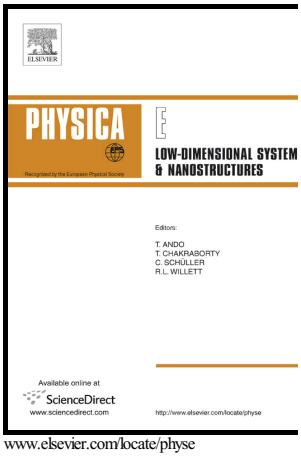
Abbas Assadi, Manouchehr Salehi, Mehdi Akhlaghi



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Orientation Dependent Size Effects in Thermal Buckling and Post-Buckling of Nanoplates with Cubic Anisotropy

Abbas Assadi [*], Manouchehr Salehi [+], Mehdi Akhlaghi [**]

[*] **PhD Student of Mechanical Engineering, *Email*: assadi@aut.ac.ir, *Tel*: +989128239049.**

[+] ***Corresponding Author*: Associate Professor of Mechanical Engineering,**
Email: msalehi@aut.ac.ir, *Tel*: +989124988984 , *Fax*: +982166419736.

[**] **Professor of Mechanical Engineering, *Email*: makhlagi@aut.ac.ir, *Tel*: +9821664543419.**

Mechanical Engineering Department, Amirkabir University of Technology (AUT), Tehran 15914, Iran

Abstract

In this work, a continuum model is presented for size and orientation dependent thermal buckling and post buckling of anisotropic nanoplates considering surface and bulk residual stresses. The model with von-Karman nonlinear strains and material cubic anisotropy of single crystals contains two parameters that reflect the orientation effects. Using Ritz method, closed form solutions are given for buckling temperature and post buckling deflections. Regarding self-instability states of nanoplates and their recovering at higher temperatures, an experiment is discussed based on low pressurized membranes to verify the predictions. For simply supported nanoplates, the size effects are lowest when they are aligned in [100] direction. When the edges get clamped, the orientation dependence is ignorable and the behavior becomes symmetric about [510] axis. The surface residual stress makes drastic increase in buckling temperature of thinner nanoplates for which a minimum thickness is pointed to stay far from material softening at higher temperatures. Deflection of [100]-oriented buckled nanoplates is higher than [110] ones but this reverses at higher temperatures. The results for long nanoplates show that the buckling mode numbers are changed by orientation which is verified by FEM.

Keywords

Anisotropic nanoplates; Equilibrium criterion; Thermal instability; Size effects; Orientation effects; Surface stresses.