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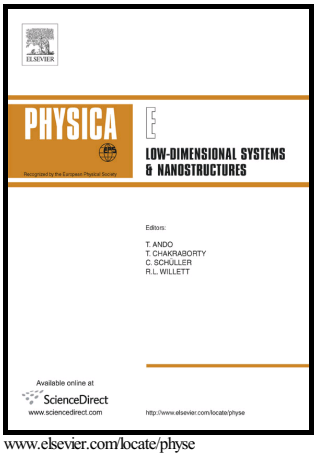

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PII: S1386-9477(17)31171-2
DOI: https://doi.org/10.1016/j.physe.2017.09.026
Reference: PHYSE12926

To appear in: *Physica E: Low-dimensional Systems and Nanostructures*

Received date: 3 August 2017
Accepted date: 25 September 2017

Cite this article as: Raffaele Barretta, Francesco Fabbrocino, Raimondo Luciano and Francesco Marotti de Sciarra, Closed-form solutions in stress-driven two-phase integral elasticity for bending of functionally graded nano-beams, *Physica E: Low-dimensional Systems and Nanostructures,* https://doi.org/10.1016/j.physe.2017.09.026

Closed-form solutions in stress-driven two-phase integral elasticity for bending of functionally graded nano-beams

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Abstract

Strain-driven and stress-driven integral elasticity models are formulated for the analysis of the structural behaviour of fuctionally graded nano-beams. An innovative stress-driven two-phases constitutive mixture defined by a convex combination of local and nonlocal phases is presented. The analysis reveals that the Eringen strain-driven fully nonlocal model cannot be used in Structural Mechanics since it is ill-posed and the local-nonlocal mixtures based on the Eringen integral model partially resolve the ill-posedeness of the model. In fact, a singular behaviour of continuous nano-structures appears if the local fraction tends to vanish so that the ill-posedness of the Eringen integral model is not eliminated. On the contrary, local-nonlocal mixtures based on the stress-driven theory are mathematically and mechanically appropriate for nanosystems. Exact solutions of inflected functionally graded nanobeams of technical interest are established by adopting the new local-nonlocal mixture stress-driven integral relation. Effectiveness of the new nonlocal approach is tested by comparing the contributed results with the ones corresponding to the mixture Eringen theory.

Key words: Integral nonlocal model, nano-beams, functionally graded material, size effects, analytical solutions.