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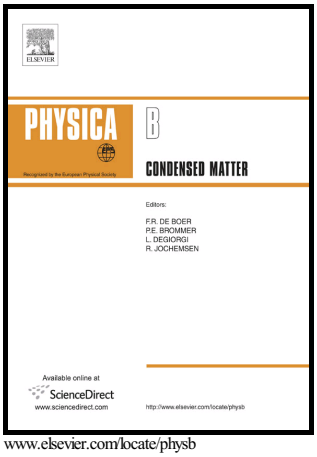

www.elsevier.com/locate/physb

PII: S0921-4526(17)30022-4
DOI: http://dx.doi.org/10.1016/j.physb.2017.01.014
Reference: PHYSB309790

To appear in: *Physica B: Physics of Condensed Matter*

Received date: 5 November 2016
Revised date: 11 January 2017
Accepted date: 12 January 2017

Cite this article as: M. Mohammadimehr, A.A. Mohammadi Dehabadi and Z Khoddami Maraghi, The effect of non-local higher order stress to predict th nonlinear vibration behavior of carbon nanotube conveying viscous nanoflow *Physica B: Physics of Condensed Matter* http://dx.doi.org/10.1016/j.physb.2017.01.014

The effect of non-local higher order stress to predict the nonlinear vibration behavior of carbon nanotube conveying viscous nanoflow

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Abstract

In this research, the effect of non-local higher order stress on the nonlinear vibration behavior of carbon nanotube conveying viscous nanoflow resting on elastic foundation is investigated. Physical intuition reveals that increasing nanoscale stress leads to decrease the stiffness of nanostructure which firstly established by Eringen's non-local elasticity theory (previous nonlocal method) while many of papers have concluded otherwise at microscale based on modified couple stress, modified strain gradient theories and surface stress effect. The non-local higher order stress model (new nonlocal method) is used in this article that has been studied by few researchers in other fields and the results from the present study show that the trend of the new nonlocal method and size dependent effect including modified couple stress theory is the same. In this regard, the nonlinear motion equations are derived using a variational principal approach considering essential higher-order non-local terms. The surrounded elastic medium is modeled by Pasternak foundation to increase the stability of system where the fluid flow may cause system instability. Effects of various parameters such as non-local parameter, elastic foundation coefficient, and fluid flow velocity on the stability and dimensionless natural frequency of nanotube are investigated. The results of this research show that the small scale parameter based on higher order stress help to increase the natural frequency which has been approved by other small scale theories such as strain gradient theory, modified couple stress theory and experiments, and vice versa for previous nonlocal method. This study may be useful to measure accurately the vibration characteristics of nanotubes conveying viscous nanoflow and to design nanofluidic devices for detecting blood Glucose.

Keywords: Nonlinear vibration analysis; Non-local higher order stress elasticity theory; Carbon nanotube conveying viscous nanoflow; Modified couple stress theory.

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