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On the bending and stability of nanowire using various HSDTs

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Abstract. In this article, various higher-order shear deformation theories (HSDTs) are developed for bending and buckling behaviors of nanowires including surface stress effects. The most important assumption used in different proposed beam theories is that the deflection consists of bending and shear components and thus the theories have the potential to be utilized for modeling of the surface stress influences on nanowires problems. Numerical results are illustrated to prove the difference between the response of the nanowires predicted by the classical and non-classical solutions which depends on the magnitudes of the surface elastic constants.

Keywords: surface effects; nanowires; bending; buckling

1. Introduction

The nanowires (NW)-based devices have found considerable range of applications in physics, engineering, and several other fields (Craighead 2000, Ekinci and Roukes 2005, He and Lilley 2008a, Jiang and Yan 2010, Liu *et al.* 2012, Wang and Feng 2009, Li *et al.* 2011, Chiu and Chen 2011a, Wang and Yang 2011, Eltaher *et al.* 2014). In physical applications, nanowires are often employed in advanced technological devices such as sensors, actuators, transistors, and resonators in nanoelectromechanical systems (NEMSs) (Craighead 2000, Ekinci and Roukes 2005). As is well known, conventional beam models failed to explain the size dependent mechanical response of nanostructrures. In the past few years, beam theories have been developed based on non-conventional continuum theories, such as the surface elasticity theory, strain gradient theory, and coupled stress theory to account for the size effect of 1D nanoscale structures (Al-Basyouni *et al.* 2015). Among these efforts, beam models based on the surface elasticity theory are attracting more and more attention due to their solid physical background (Wang and Feng 2009, Song and Huang 2009, Chiu and Chen 2011b, Ansari and Sahmani 2011, Mahmoud *et al.* 2012, Hosseini-Hashemi *et al.* 2013).

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