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Effect of Surface Energy on Nano-Resonator Dynamic Behavior

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Abstract

Presented herein is a comprehensive analysis on the size-dependent dynamic behaviors of electrostatically actuated nano-resonator including surface stresses effect. To this end, partial differential equation of nano-resonator based on Gurtin–Murdoch and Euler–Bernoulli theories is converted to ordinary differential equation utilizing assumed mode method.

Effect of applied DC voltage on stability and bi-stability of nano-resonator is investigated and it revealed that surface elasticity and stress affect the bi-stability region of nano-resonator. By plotting frequency response of the resonator, hardening and softening behavior of nano-resonator are analyzed and it is shown that surface effect may change the hardening and softening behavior of nano-resonators.

Keywords: Nano-resonator, surface elasticity theory, softening hardening, bi-stability.

1. Introduction

Micro- and nano- electromechanical systems (MEMS/NEMS) have attracted the attention of research community according to broad applications such as biosensors, resonators, micro-pumps, micro-mirrors, accelerometers , nano-switches, nano-tweezers and random access memory [1-3].

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