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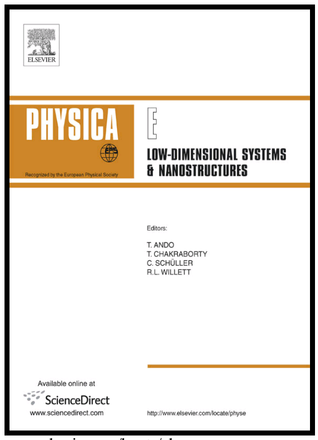

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A refined integro-surface energy-based model for vibration of magnetically actuated double-nanowire-systems carrying electric current

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Abstract

A novel surface energy-based model is developed to examine more precisely vibrations of current-carrying double-nanowire-systems immersed in a longitudinal magnetic field. Using Biot-Savart and Lorentz laws, a more refined version of interwire interactional magnetic forces is presented. By employing Rayleigh beam theory, the equations of motion are derived. In fact, these are coupled integro-differential equations which are more accurate with respect to those of the previously developed models. For simply supported and clamped nanosystems, governing equations are analyzed via assumed mode method. The effects of interwire distance, slenderness ratio, electric current, magnetic field strength, and surface effect on the fundamental frequency are addressed carefully. The obtained results display the importance of exploiting the refined model for vibration analysis of nanosystems with low interwire distance, high electric current, and high magnetic field strength.

Keywords: Transverse vibrations; Double-nanowire-systems; Direct electric current; Longitudinal magnetic field; Surface energy effect; Assumed mode method.

1. Introduction

The assembly of nanowires (NWs) into nanodevices and nanoscale circuits brings about diverse applications in nanoelectronics [1, 2], nanogenerators [3–5], nanophotonics [6–8], and

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