On modeling wave dispersion characteristics of protein lipid nanotubules

Farzad Ebrahimi, Ali Dabbagh

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On modeling wave dispersion characteristics of protein lipid nanotubules

Farzad Ebrahimi[1]*, Ali Dabbagh[2]

[1]*Department of Mechanical Engineering, Faculty of Engineering, Imam Khomeini International University, Qazvin, Iran*

[2]*School of Mechanical Engineering, College of Engineering, University of Tehran, Tehran, Iran*

* Corresponding author email: febrahimy@eng.ikiu.ac.ir (F. Ebrahimi).

Abstract

In this article, wave propagation characteristics of protein lipid nanotubules are covered with respect to scale effects utilizing nonlocal strain gradient theory. The structure is supposed to be modeled as a simply supported beam and the kinematic relations are derived based on the classical beam theory (CBT). Implementing an energy based approach, the Euler-Lagrange equations of the lipid tubules are obtained. Moreover, the final governing equations are solved analytically to achieve the wave frequency and phase velocity of propagated waves. Influences of small size and wave number on the wave dispersion responses of lipid nanotubules are shown in detail in different diagrams for both phase velocity and wave frequency. Also, accuracy of introduced model is verified comparing responses of present model with those of former papers.

Keywords: Wave propagation, lipid nanotubule, nonlocal strain gradient theory

1. Introduction

There is a particular structural feature in the self-assembled lipid tubules which unlimbers a lot of applications for such elements as organized samples for the use of protein crystallization (Wilson-Kubalek et al., 1998), protein metallization (Delclos et al., 2008; Patil et al., 2003) and drug delivery components (Meilander et al., 2003). Indeed, lipid tubules are consisted of crystalline bilayer walls which generate this wide range of applicability for them. Due to this