Advances in Aircraft and Spacecraft Science, *Vol. 6, No. 1 (2019) 001-018*
DOI: https://doi.org/10.12989/aas.2019.6.1.001

Small-scale effect on the forced vibration of a nano beam embedded an elastic medium using nonlocal elasticity theory

Samir Belmahi*[1, 2], Mohammed Zidour[1, 3] and Mustapha Meradjah[2]

[1]*Department of Civil Engineering ,University of Ibn Khaldoun, PB 78 Zaaroura, 14000 Tiaret, Algeria.*
[2]*Laboratory of Materials and Hydrology, University of Djillali Liabes,Sidi Bel Abbés, Algeria*
[3]*Laboratory of Geomatics and Sustainable Development, University of Ibn Khaldoun Tiaret, Algeria*

(Received May 7, 2018, Revised August 4, 2018, Accepted August 6, 2018)

Abstract. This present article represents the study of the forced vibration of nanobeam of a single-walled carbon nanotube (SWCNTs) surrounded by a polymer matrix. The modeling was done according to the Euler-Bernoulli beam model and with the application of the non-local continuum or elasticity theory. Particulars cases of the local elasticity theory have also been studied for comparison. This model takes into account the different effects of the interaction of the Winkler's type elastic medium with the nanobeam of carbon nanotubes. Then, a study of the influence of the amplitude distribution and the frequency was made by variation of some parameters such as (scale effect (e_0^a), the dimensional ratio or aspect ratio (L/d), also, bound to the mode number (N) and the effect of the stiffness of elastic medium (K_w). The results obtained indicate the dependence of the variation of the amplitude and the frequency with the different parameters of the model, besides they prove the local effect of the stresses.

Keywords: carbon nanotube; nanocomposite; nanobeam; vibration; Euler-Bernoulli; Winkler

1. Introduction

The use of carbon nanotubes in the manufacturing of nanocomposites is one of the most important topics now in materials sciences. Since their discoveries by Sumio Iijima in 1991 (Iijima 1991) are a fundamental part of nanotechnology studies (Ahmadi Asoor *et al*. 2016). Carbon nanotubes have attracted many research activities, which are closely related to their extraordinary electrical, mechanical, thermal, physical and chemical properties (Ahmadi Asoor *et al*. 2016, Kiani 2014a). Carbon nanotube technologies have many applications for to the aerospace industry. It is an advanced composite material of the future in aerospace industry (Mrazova, 2013, Harris 2009). Their use is based on the knowledge at different scales, of their behavior and characteristics (Hurang *et al*. 2010) considering the different factors which are involved (Shehata *et al*. 2011).

The nanocomposites are materials with a nanometric structure (Acton 2013, Okpala 2014) on a scale that lies between 1 and 100 nm (de Azeredo *et al*. 2009). They have the capacity to improve the macroscopic properties of the products (Okpala 2013) as well as the mechanical properties (Sachse *et al*. 2013), without compromising the ductility of the material (Bakis *et al*. 2002). In fact, the small size of these particles does not create a large concentration of constraints (Okpala

*Corresponding author, Ph.D., E-mail: belmasamir@yahoo.fr

http://www.techno-press.org/?journal=aas&subpage=7 ISSN: 2287-528X (Print), 2287-5271 (Online)

thermoelastic bending of functionally graded sandwich plates", *Aerosp. Sci. Technol.*, **24**(1), 209-220.

Yazid, M., Heireche, H., Tounsi, A., Bousahla, A.A. and Houari, M.S.A. (2018), "A novel nonlocal refined plate theory for stability response of orthotropic single-layer graphene sheet resting on elastic medium", *Smart Struct. Syst.*, **21**(1), 15-25.

Youcef, D.O., Kaci, A., Benzair, A., Bousahla, A.A. and Tounsi, A. (2018), "Dynamic analysis of nanoscale beams including surface stress effects", *Smart Struct. Syst.*, **21**(1), 65-74.

Younsi, A., Tounsi, A., Zaoui, F.Z., Bousahla, A.A. and Mahmoud, S.R. (2018), "Novel quasi-3D and 2D shear deformation theories for bending and free vibration analysis of FGM plates", *Geomech. Eng.*, **14**(6), 519-532.

Zemri, A., Houari, M.S.A., Bousahla, A.A. and Tounsi, A. (2015), "A mechanical response of functionally graded nanoscale beam: An assessment of a refined nonlocal shear deformation theory beam theory", *Struct. Eng. Mech.*, **54**(4), 693-710.

Zidi, M., Tounsi, A., Houari, M.S.A. and Bég, O.A. (2014), "Bending analysis of FGM plates under hygro-thermo-mechanical loading using a four variable refined plate theory", *Aerospace Sci. Tech.*, **34**, 24-34.

Zine, A., Tounsi, A., Draiche, K., Sekkal, M. and Mahmoud, S.R. (2018), "A novel higher-order shear deformation theory for bending and free vibration analysis of isotropic and multilayered plates and shells", *Steel Compos. Struct.*, **26**(2), 125-137.

AP