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PII: S0263-8223(17)32876-3
DOI: https://doi.org/10.1016/j.compstruct.2018.03.012
Reference: COST 9459

To appear in: *Composite Structures*

Received Date: 5 September 2017
Revised Date: 21 February 2018
Accepted Date: 7 March 2018

Interfacial effects on the damping properties of general carbon nanofiber reinforced nanocomposites-A multi-stage micromechanical analysis

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Abstract: Damping properties of polymer matrix nanocomposites (NC) reinforced by vapor grown carbon fiber (VGCF) are investigated by presenting a multi-stage analytical micromechanical model. A third phase as interphase is considered due to the complex chemical and physical state in the region near to matrix/fiber interface. Both uniform and graded properties of the interphase through the thickness are considered. Acceptable agreements in comparison with experiments and appropriate mesh sensitivity analysis prove the efficiency and accuracy of the proposed model. The effects of various meaningful parameters, including the interphase bonding strength, thickness and types and also the VGCF volume fraction, aspect ratio, orientation, diameter, waviness and cone angle are investigated. Stored and dissipated energy in the NC constituents are obtained as well. It is concluded that the NCs reinforced by long nanofiber possess greater storage and loss modulus than the NCs owing short fiber. However, the specific damping capacity picks lower values. Higher bonding strength and lower thickness of the interphase enhance the NC effective damping properties. Increasing VGCF diameter, waviness and cone angle result declining in the damping properties. The interphase portion in the stored and dissipated energy increases by decreasing the interphase bonding strength and increasing the interphase thickness.

Keyword: Damping properties, Polymer nanocomposites, Interfacial effects, Micromechanics.

1- Introduction

Structures experiencing dynamic loadings can be exposed to a high level of vibration which causes unwanted high noise level and human discomposure [1, 2]. Damping is beneficial in the realm of suppression of resonant and near-resonant vibrations [3, 4]. Hence, vibration damping forms an important aspect of structural health of