Nonlinear Bending of Functionally Graded Dielectric Composite Plate Reinforced by Graphene Platelets

Yu Wang, Chuang Feng, Zhan Zhao, Jie Yang
School of Engineering, RMIT University, Bundoora, VIC 3083 Australia

Abstract

This paper investigates the nonlinear bending performances of a multi-layer functionally graded composite plate reinforced by graphene platelets (GPLs). The GPL concentration varies through the thickness of the plate according to four prescribed distribution patterns. The electrical potential applied on each individual layer are determined by using Maxwell theory. The material properties of the composites, i.e. the Young's modulus and dielectric permittivity, are obtained by using effective medium theory (EMT). Within the framework of the first-order shear deformation theory and von Kármán nonlinear strain-displacement relationship, governing equations for the nonlinear bending of the beam are established. These governing equations are numerically solved by using differential quadrature method (DQM). The effects of several influencing factors, including the dimensions of the GPLs and the magnitude and frequency of electrical voltage, on the nonlinear bending behaviours of the composite plate are comprehensively investigated. The analysis demonstrated that the composite plate's performances can be designed and actively tuned by varying the attributes of the reinforcements and applied electrical voltage.

Keywords

Nonlinear bending; Graphene platelet; Functionally graded; Dielectric permittivity