Summary: The present paper is concerned with nonlinear vibration of a simply supported functionally graded graphene reinforced composite (GRC) cylindrical panel subjected to the transverse excitation. Functionally graded structure is proposed to distribute more graphene platelets (GPLs) to the most needed layer for the optimal performance. The modified Halpin-Tsai model and the rule of mixture are carried out to predict the effective material properties of the GRC cylindrical panel, such as Young’s modulus, Poisson’s ratio and mass density. Nonlinear partial differential equations of motion are established within the framework of Hamilton principle in conjunction with first-order shear deformation theory (FSDT) and von Karman geometric nonlinearity. Navier approach is adopted to calculate natural frequencies of the GRC cylindrical panel. Then, considering the external excitation, Galerkin method is applied to realize the model reduction, which is expressed by the ordinary differential equations. Backward Differentiation Formula (BDF) is used to perform nonlinear transient responses of the system subjected to the pulse excitation (step load or triangular load). Finally, Runge-Kutta method is employed to carry out bifurcations and chaotic dynamics of the system subjected to the steady-state excitation. Results are presented in the form of natural frequencies and nonlinear responses to perform the parametric studies, such as distribution types and weight fractions of GPLs, geometry parameters and excitation parameters of the GRC cylindrical panel.

MSC:
74Kxx Thin bodies, structures
74-XX Mechanics of deformable solids
74Gxx Equilibrium (steady-state) problems in solid mechanics

Keywords:
graphene platelets; cylindrical panel; nonlinear transient responses; chaotic dynamics

Full Text: DOI

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