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Abstract

The high mechanical strength and superior physical properties of graphene and its derivatives [1] have made them an ideal choice for modern engineering structures. The use of graphene as nanofillers in reinforced polymer composites has led to the development of sustainable high performance composite materials [2]. Such materials can be utilized in engineering structures not only to improve their structural performance but also to reduce their environmental impact as well. Skew plates are commonly used in aerospace structures and ship hulls. In this paper, a size-dependent nonlinear model is presented for bending analysis of composite laminated micro skew plates reinforced with functionally graded graphene sheets. The modified Halpin-Tsai micromechanical model [3] and rule of mixture are considered for the effective mechanical properties of graphene sheets which vary continuously throughout the thickness of the skew plate. The Schapery's model [4] is considered for the effective thermal properties. The skew plate is assumed in thermal environments while transversely loaded. The governing equations of the problem are derived based on the Mindlin plate theory and the modified coupled stress theory. Using the generalised differential quadrature method, the nonlinear governing equations are first converted into a set of linear algebraic equations and then solved to obtain the bending moment of the skew plate under different loading conditions. Results show that reinforcing composite laminated micro skew plates with functionally graded graphene sheets increases the overall stiffness and bending strength of the plate, enhancing its performance under large deflections. It has also been observed that the bending performance of the skew plate further enhances through changing the distribution pattern of the functionally graded graphene reinforcement as well as with an increase in the angle of the skew plate.

Key words: *Bending analysis; Micro skew plate; Functionally graded graphene; Generalized differential quadrature; Modified couple stress theory*

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