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Isogeometric Thermal buckling Analysis of Temperature Dependent FG Graphene Reinforced Laminated Plates using NURBS Formulation

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Abstract

Present research aims to analyse the thermal buckling response of composite laminated plates reinforced with graphene sheets. Volume fraction of graphene in each layer may be different which results in a piecewise functionally graded material. All of the thermomechanical properties of the matrix and graphene sheets are assumed to be temperature dependent. A micromechanical approach is used to estimate the thermomechanical properties of the composite media. Using the first order shear deformation plate theory, the strain energy of the plate and the work done by the thermally induced prebuckling forces are obtained. Afterwards, a non-uniform rational B-spline (NURBS) based isogeometric finite element method is used to study the thermal buckling response of the graphene reinforced composite plates. A detailed study is provided to investigate the effects of boundary conditions, functionally graded pattern, aspect ratio and side to thickness ratio of the plate.

Keywords: Thermal buckling; Composite plate; Graphene Reinforced Composite; NURBS formulation; Temperature Dependency; Halpin-Tsai rule.

1 Introduction

Graphene is a two dimensional carbon based structure. This type of nano dimensional material was introduced in 2004 [1]. It is a monolayer with atomic thickness which is composed of carbon atoms in a hexagonal pattern. Graphene has interesting features such as high electrical and thermal conductivities, great mechanical strength, large specific surface area, and low manufacturing cost in comparison to other nanostructures. Exceptional mechanical, thermal, optical and electrical properties of graphene have necessitated the researchers to explore the extraordinary features of this nanostructure in different fields of science and technology [2–6]. As a result, graphene is an excellent candidate for the reinforcement of the composites.

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