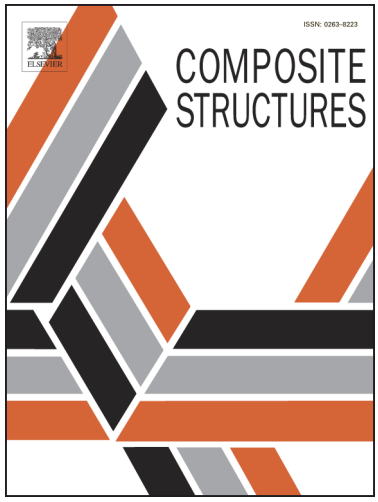

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Predictions of transverse thermal conductivities for plain weave ceramic matrix composites under in-plane loading

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ABSTRACT

A coupled temperature-displacement steady-state analysis of plain weave ceramic matrix composites along through-thickness direction was reported in this paper. Based on the formulation of Binary Model, a meso-scale 2×2 unit cell model of plain weave composites was established. The periodic displacement boundary conditions and through-thickness temperature gradient were imposed. The non-linear strain-dependent thermal properties of constituent materials have been discretised by multi-linear curves, which have been implemented by the user defined subroutine, USDFLD of the finite element package, Abaqus. The degradation of the composite through-thickness thermal conductivity with uni-axial straining has been predicted. The predictions considering tow waviness have a good agreement with experimental results. The analysis indicates that the degradation of through-thickness thermal conductivities is due to the combination of shear failure and wake debonding mechanisms. The matrix/medium played an important role in the through-thickness heat flow of plain weave ceramic matrix composites.

Keywords: Ceramic matrix composites; Plain weave composites; Thermal conductivities; Waviness; Finite element analysis

1. Introduction

Composite materials and composite structures are receiving a growing interest in the field of advanced engineering applications [1-7]. Owing to their low density, high modulus and good thermal stability, ceramic matrix composites (CMCs) have been regarded as high-temperature structural materials for aero engine components, such as combustor liners, exhaust nozzles and turbine guide vanes etc. Numerous research has