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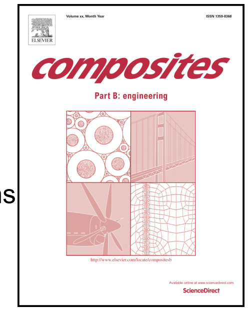

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Multi-coating inhomogeneities approach for composite materials with temperature-dependent constituents under small strain and finite thermal perturbation assumptions

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Abstract

A multi-coated inhomogeneities mean field micromechanics approach is proposed to predict the overall thermoelastic properties, namely, elasticities, thermal expansions and heat capacity, of a thermoelastic composite material with temperature-dependent constituents under finite temperature changes and small strain assumptions. First, the Helmholtz potential density for small strain finite thermoelasticity has been presented. Then the fundamental solution based on Green's function of thermoelasticity problem has been used to derive the general expressions for the elastic and thermal strains concentration tensors with temperature-dependent material properties. Numerical examples based on the multi-coating Mori-Tanaka model are used to quantify the differences of the effective properties based on the small strain finite thermoelasticity in comparison to the linear thermoelasticity. The predictions of the present mean field micromechanics model are compared to those of the variational asymptotic method for unit cell homogenization (VAMUCH), a finite element based micromechanics model.

Keywords: A. Particle-reinforcement, A. Fibres, B. Thermomechanical, C. Micro-mechanics

1. Introduction

Several engineering composite materials contain an interphase between a matrix phase and reinforcements like fibers, inclusions, etc. Such interphase may significantly change the mechanical properties of composite materials. In many engineering applications, materials are often suggested to thermo-mechanical loading. In thermoelastic composite materials, significant thermal stresses can arise due to the mismatch in the coefficient of thermal expansions (CTEs) of the constituents, affecting their global performances. To study the thermomechanical behavior of composite materials, the so-called linear thermoelasticity which, in addition to the temperature-independence, assumes that both the strains and the temperature relative variations are small, is often used. The small temperature relative variations implies that the temperature increment is small relative to

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