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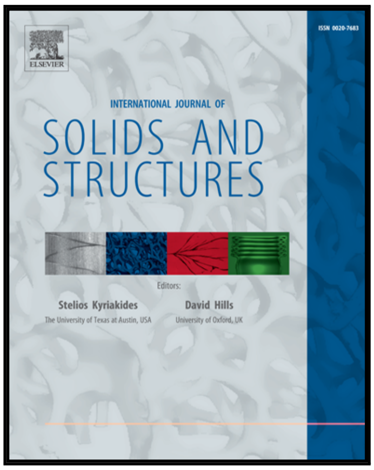

FFT based iterative schemes for composites conductors with non-overlapping fibers and Kapitza interface resistance

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FFT based iterative schemes for composites conductors with non-overlapping fibers and Kapitza interface resistance

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Abstract

A FFT-based iterative scheme is developed for fiber-made composite conductors with a Kapitza thermal resistance between the matrix and the inclusions which involves a jump of the temperature. To reach this objective, we propose to extend the FFT methods to deal with Kapitza interface and to derive the size-dependent effective conductivity of such composites conductors. In this paper, we solve the in-plane problem leading to the identification of the transverse effective conductivity. The original methods based on Fast Fourier Transform failed to solve efficiently the problems with imperfect interface which is intrinsically attributable to the use of Fourier series to describe the local fields. To reach this objective, we propose to derive an iterative scheme obtained from the weak form of the boundary value problem by considering a discretization along Fourier series and an enrichment with functions which are null outside of the inclusions. By doing so, the latter introduce explicitly the discontinuities at the interface. The stationarity point is computed by means of an iterative which uses the classic periodic Green function and a modified conductivity tensor that accounts for the interface thermal resistance. It is shown that the rate of convergence of this new iterative scheme is almost equivalent to that of the original method. The results for a composite with regularly distributed fibers are compared with Finite Element solutions. Next, the size-dependent effective conductivity is computed for random distributions of inclusions and compared with analytic estimates coming from the homogenization theory.

Keywords: Composites, Conductivity, Homogenization, FFT, Imperfect interface

1. Introduction

Surface/interface effects have been introduced to account for the discontinuity of the local fields across the interface between two regions having distinct

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