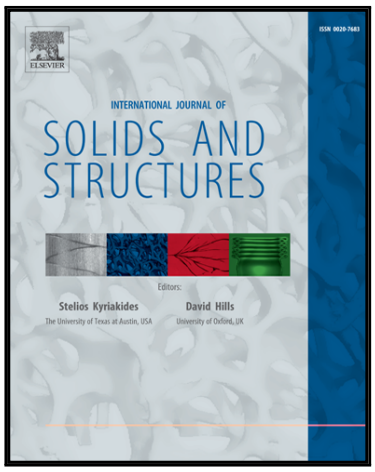

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EFFECT OF CYLINDRICAL FIBERS, WITH CROSS-SECTIONS FORMED BY TWO CIRCULAR ARCS, ON THE OVERALL CONDUCTIVITY OF A COMPOSITE.

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Abstract.

An analytic solution for the steady-state temperature distribution in an infinite conductive medium, containing non-conductive fiber with the cross-section of irregular shape formed by two circles, and subjected to remotely applied uniform heat flux is obtained. The temperature flux on the surface of the inhomogeneity is then determined as a function of the geometrical parameters. This result is used to calculate resistivity contribution tensor for the fiber and to evaluate effective conductive properties of a material containing multiple inhomogeneities of this shape.

Keywords

Fiber reinforced composite; irregular cross-section; bipolar coordinates; temperature field; effective conductivity.

1. Introduction.

In this paper, we discuss materials containing a non-conductive cylindrical inhomogeneity with a cross-section formed by two circles. We distinguish between four different shapes of the cross-section presented in Figure 1: (a) two separate circles (auxiliary problem), (b) cross-section formed by union of two overlapping circles of generally different radii, (c) lenticular cross-section (that is mathematically a particular case of two overlapping circles), and (d) lunar cross-section (including arc crack as a limiting case). Such inhomogeneities occur in both natural and man-made materials. Figure 2 provides several examples: (a) electrospinned polystyrene fiber (from Liu et al, 2015) (b) oxidized polyacrylonitrile fiber (from Marcuzzo et al, 2013) (c) natural sisal fiber (Monteiro et al,