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RESURGENCE EDGE EFFECTS IN COMPOSITES: FORTUITY AND GEOMETRY

NATALIA RYLKO[†] and RYSZARD WOJNAR[‡]

[†] *Department of Technology, Pedagogical University, 2, Podchorążych Str., 30-084 Kraków, Poland*

[‡] *Institute of Fundamental Technological Research, Polish Academy of Sciences* 5^B*, Pawińskiego Str., 02-106 Warsaw, Poland*

Abstract. The thermal edge effects in two-dimensional composite are investigated. The composite consists of a weakly conducting half-plane, in which ideally conductive circular disks are distributed by random. The half plane is heated on its boundary, and, according to Fourier's law a temperature field rises up in the whole half-plane. The temperature fields in random composites depend strongly on distribution of inclusions, and though in the scale of the whole half-plane it can be approximated by a homogenized smooth fields, their behaviour at the edge is not so smooth and the local effects are dominant. In particular, near the boundary of composites high oscillations of the heat flux with opposite directions are observed. We explain this and show that the percolation chains of the perfectly conducting inclusions can appear, and the oscillatory behaviour is relate to the resurgence flows observed at the half-plane edge. The results are also a warning against uncritical using of homogenisation methods in composites near of percolation threshold.

1. Introduction

Complex physical phenomena in composites and porous media are frequently explained by general suggestions that many various physical factors should be taken into account to explain an anomalous behavior. For instance, it is suggested to explain some subtle effects in heat conduction by non-linearity, thermal radiation etc. Such an opinion arises due restrictions of the pure numerical methods applied to computer simulations of the densely packed random composites. Though the majority of the authors declare that they can compute everything, computational