Abstracts of MMA2010, May 26 - 29, 2010, Druskininkai, Lithuania

DEPENDENCE OF THE EFFECTIVE CONDUCTIVITY OF 2D COMPOSITE MATERIALS ON DOMAIN PERTURBATIONS

A. KOROLEVA, S. ROGOSIN and A. SHATSKO

Belarusian State University

Nezavisimosti ave 4, BY-220030, Minsk, Belarus

E-mail: `ankakoroleva@gmail.com; rogosin@gmail.com`

Analytical methods applied at the study of a steady heat conduction in various types of composites are described in [1]. Several analytical formulas for the effective (macroscopic) conductivity tensor which are deduced by using different approaches based on the recent results in the theory of partial differential equations and complex analysis (see also [2] and references therein). We can mention here Clausius-Mossotti formula (for small concentration of inclusions), Dykhne formula (for symmetric composite with three components), generalized Keller-Dykhne formula (for self-dual two-phase system with arbitrary concentration of compact inclusions of one phase into another), Mityushev's formula (for circular inclusions in 2D composites).

The main goal of the work is to study the dependence of the effective (macroscopic) conductivity tensor on the local perturbation of a finite number of initial circular inclusions. For sake of simplicity we consider only potential steady heat flow under ideal contact condition. This problem leads to $\mathbb{R}$-linear conjugation problem for analytic functions in multiply connected domain (see [1])

$$\phi(t) = \phi_k(t) - \rho\overline{\phi_k(t)} - t, \quad t \in \Gamma_k, \quad k = 1, \dots, n, \tag{1}$$

where ρ is Bergman parameter (see, e.g. [1]).

In the case when Γ_k are circles the system of relations (1) are solved (see [2]) by using the method of the functional equations and the method of successive approximation. On the base of this solution an exact formula for effective conductivity is found (see [3]).

The changes in this formula caused by the local perturbation of the inclusion are studied. The machinery of this work is based on the approach of M. Lanza de Cristoforis developed in [4], [5].

The work is partially supported by the Belarusian Fund for Fundamental Scientific Research.

REFERENCES

[1] V.V. Mityushev, E.V. Pesetskaya, S.V.Rogosin. Analytical Methods for Heat Conduction in Composites and Porous Media. In: *Thermal Properties of Cellular and Porous Materials*, A. Öchsner, G. Murch, and M. de Lemos (Eds.), Wiley-VCH, Amsterdam, 2008, 124 – 167.

[2] V.V. Mityushev, S.V.Rogosin. *Constructive Methods for Linear and Nonlinear Boundary Value Problems for Analytic Functions: Theory and Applications.* Chapman & Hall/ CRC Press, Boca Raton - London, 1999.

[3] V.V. Mityushev. Transport properties of two-dimensional composite materials with circular inclusions. *Proc. R. Soc. A*, **455** :2513–2528, 1999.

[4] M. Lanza de Cristoforis, S.V. Rogosin. Analiticity of a Nonlinear Operator Associated to the Conformal Representation in Schauder Spaces. An Integral Equation Approach. *Math. Nachr.*, **220** :59–77, 2000.

[5] L. Preciso, S. V. Rogosin. Real analyticity of an operator, associated to the Schwarz operator for multiply connected domains. *Proc. of Institute of Math., NAS Ukraine*, **1** (3):151–168, 2004.