Numerical modelling of elastic, magnetic and electric fields as well as transport properties in multiphase composite materials

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The composite materials, which contain both ferroelectric and ferromagnetic phases exhibit coupled magnetoelectric effect when either mechanical, electric or magnetic field is active. This effect is provided by microstructural changes of the crystal symmetry by domain shifting on microstructural level. The coupled acting of the fields can lead to appearance of defects in those brittle materials. Such defects as cracks or cavities can change the material behavior, which can also lead to further destruction and makes the exploitation of the material impossible. We consider macromodel of material plane for composites with dielectric, ferromagnetic and magnetoelastic inclusions. The local fields in the structures were written using the complex potentials method. The corresponding boundary-value conditions were written. To estimate the thermal and electric conductivity in composite with random inclusions the R-linear boundary-value problem of complex function was developed. The Shwartz alternating method was used. The constructions of periodical and quasi-periodical functions were implied. The local fields in most cases were found in form of Cauchy type integrals as numerical functionals of obtained earlier scalar and vector functions. The solution was reduced to the systems of singular integral equations. The cracks defects in magnetoelecroelasticity were represented as polynomials, the asymptotic values of fields at the ends of the cracks were written. The techniques mentioned above provided application of mechanical quadratures method, the numerical simulations for the local fields in magnetoelectroelasticity and conductivity were provided. The stress intensity factors, and the effective conductivity tensor were obtained.