Maxwell homogenization scheme as a rigorous method of micromechanics

The Maxwell's homogenization scheme (MHS) has been formulated in terms of the dipole moments and contribution tensors of the representative volume element (RVE) of actual composite and equivalent inclusion. Provided the interactions among the inclusions were taken into account, this scheme is asymptotically exact in the sense that the effective properties converge to its exact value with increasing RVE size. This proves MHS as a rigorous method of micromechanics, applicable to a variety of problems for composites of arbitrary microstructure. To demonstrate its potential, the conductivity problem for a composite with equally oriented spheroidal inclusions is considered. The convergence of solution is explored and an effect of structural parameters on the effective conductivity of composite has been evaluated. The methodological issues of MHS application are discussed including an appropriate shape of the composite RVE and equivalent inclusion. It is shown that intelligent (taking the microstructure of composite into account) shape choice accelerates convergence of solution. Practical importance of the developed approach consists in its direct applicability to RVE reconstructed by the instrumental methods. This makes MHS a convenient tool for estimating effective properties of composite from the observed fragment of microstructure.