

Homogenization of Heterogeneous Material Properties: Theory and Applications

S.V. Sheshenin, M.I. Savenkova

Faculty of Mechanics and Mathematics, Lomonosov Moscow State University

First, theoretical aspects of homogenization are considered, i.e. definition of homogenized properties of elastic material (averaged coefficients of linear PDE) and methods that are used for their calculation. Second, multi scale approach is discussed as powerful method that is usually employed to calculate averaged properties of periodic composite and also determine displacement, strains and stresses fluctuations in phases of the composite material. Then, some deviations from standard multi scale method are treated. Here, we consider quasi periodic media and non-linear materials. A focus is given on homogenization of plates and shells.

After all these theoretical consideration we are going to show three applications of homogenization: application to alloys, rubber-cord, corrugated and laminated plates.

Exactly, homogenization was employed for Tin-Lead alloy, which structure changed due to diffusion. We studied the solder effective elasticity moduli changes depending on material macrostructure variation. All data on microstructure were provided by colleagues from TU Berlin. For these data we observed that the structure change during the diffusion process doesn't influence the effective properties of a solder.

Also for model material we investigated dependence of effective moduli on: a) phase concentration; b) inclusions' disposition; c) inclusions' amount, d) size of representative area. For alloy effective moduli calculations were conducted using directly the definition of effective moduli.