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On Calculating Effective Elastic Properties of Media with Inclusions: Asymptotic Representations and Areas of Their Applicability

Konstantin B. Ustinov

Institute for Problem in Mechanics, RAS, Moscow, Russia

A rather general solution for calculating effective elastic moduli of media with isolated inhomogeneities (disperse composites) based on Eshelby's method of equivalent inclusion is written in the explicit form. A number of particular cases are obtained by limit transitions. For arbitrary flat ellipsoidal inclusions three particular cases have been distinguished: extremely rigid inclusions, extremely soft inclusions, inclusions of moderate rigidity. Similar formulas were obtained for needle-like inclusions. Some of the solutions coincide with the known ones, while the others appear to be new. The theoretical estimations and numerical calculations were made to assess the areas of applicability of the asymptotics, which is determined by two parameters: ratio of moduli of inclusions and matrix, and aspect ratio of inclusions.

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