

Inequalities on dilute composite materials and Eshelby's conjecture

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We make progress towards proving the strong Eshelby's conjecture in three dimensions. We prove that if for a single nonzero uniform loading the strain inside inclusion is constant and further the eigenvalues of this strain are either all the same or all distinct, then the inclusion must be of ellipsoidal shape. As a consequence, we show that for two linearly independent loadings the strains inside the inclusions are uniform, then the inclusion must be of ellipsoidal shape. We then use this result to address a problem of determining the shape of an inclusion when the elastic moment tensor (elastic polarizability tensor) is extremal. We show that the shape of inclusions, for which the lower Hashin-Shtrikman bound either on the bulk part or on the shear part of the elastic moment tensor is attained, is an ellipse in two dimensions and an ellipsoid in three dimensions.¹

¹joint work with Habib Ammari, Yves Capdeboscq, Hyeonbae Kang, Graeme W. Milton, Habib Zribi