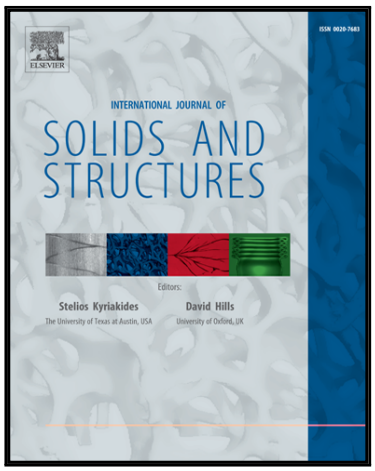

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Circular inhomogeneity with Steigmann-Ogden interface: Local fields, neutrality, and Maxwell's type approximation formula

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Abstract

The boundary conditions for the Steigmann-Ogden (1997, 1999) model are re-derived for a two dimensional surface using general expression for surface energy that include surface tension. The model treats the interface as a shell of vanishing thickness possessing surface tension as well as membrane and bending stiffness. The two-dimensional plane strain problem of an infinite isotropic elastic domain subjected to the uniform far-field load and containing an isotropic elastic circular inhomogeneity whose interface is described by the Steigmann-Ogden model is solved analytically. Closed-form expressions for all elastic fields in the domain are obtained. Dimensionless parameters that govern the problem are identified. The Maxwell type approximation formula is obtained for the effective plane strain properties of the macroscopically isotropic materials containing multiple inhomogeneities with the Steigmann-Ogden interfaces. The "neutrality" conditions are analyzed. It is demonstrated that while the Steigmann-Ogden model theoretically reduces to the Gurtin-Murdoch (1975, 1978) model when the bending interphase effects are neglected, the two models (for the case of zero surface tension) describe two very different interphase regimes of seven regimes proposed by Benveniste and Miloh (2001).

Keywords: Circular inhomogeneity, Surface effects, Steigmann-Ogden model, Effective properties

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