MICROMECHANICAL INTERACTION MODEL ACCOUNTING FOR THE SPATIAL DISTRIBUTION OF INCLUSIONS IN ELASTIC-VISCOPLASTIC COMPOSITES

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A cluster interaction model [1] was proposed to account for the spatial distribution and morphology of particles when estimating the effective properties of elastic and thermoelastic composites. In the present study, this approach is extended to elastic-viscoplastic composites. To this end, the tangent linearization of the non-linear viscoplastic law and the concept of additive interaction equation [2] are used. Although the extension is formulated for the non-linear case, first applications are considered for linear viscoelastic composites with a single family of inclusions, a situation rich enough to evaluate the interest of the cluster interaction approach.

The results of the model are compared to numerical homogenization for periodic unit cells with two cubic configurations: regular cubic and body-centered cubic. As concerns material properties of inclusions, three cases were analysed: elastic inclusions, and next viscoelastic inclusions which are stiffer or softer than the matrix, respectively. Comparisons with Finite Element simulations have shown that accounting for particle-to-particle interactions enables to significantly improve the accuracy of estimates (both in terms of overall and per phase responses) with respect to schemes ignoring these interaction effects, for instance, the additive tangent Mori-Tanaka model [3].

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References

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