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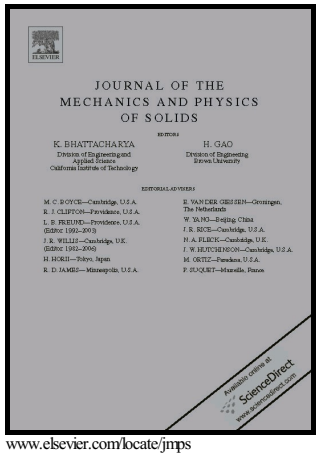

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Numerical implementation of non-local polycrystal plasticity using Fast Fourier Transforms

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Abstract

We present the numerical implementation of a non-local polycrystal plasticity theory using the FFT-based formulation of Suquet and co-workers. Gurtin's (2002) non-local formulation, with geometry changes neglected, has been incorporated in the EVP-FFT algorithm of Lebensohn et al. (2012). Numerical procedures for the accurate estimation of higher order derivatives of micromechanical fields, required for feedback into single crystal constitutive relations, are identified and applied. A simple case of a periodic laminate made of two fcc crystals with different plastic properties is first used to assess the soundness and numerical stability of the proposed algorithm and to study the influence of different model parameters on the predictions of the non-local model. Different behaviors at grain boundaries are explored, and the one consistent with the micro-clamped condition gives the most pronounced size effect. The formulation is applied next to 3-D fcc polycrystals, illustrating the possibilities offered by the proposed numerical scheme to analyze the mechanical response of polycrystalline aggregates in three dimensions accounting for size dependence arising from plastic strain gradients with reasonable computing times.

Keywords

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