

Assessing Different Self-Consistent Approximations by Comparison with Full-Field Simulations in Viscoplastic Polycrystals

Ricardo A. Lebensohn⁽¹⁾, Yi Liu⁽²⁾, Pedro Ponte Castaneda⁽²⁾

(1) *MST Division, Los Alamos National Laboratory, Los Alamos, NM*

(2) *MEAM Department, University of Pennsylvania, Philadelphia, P*

In this work we compare full-field numerical simulations for the effective behavior and the statistical field fluctuations in viscoplastic polycrystals with various estimates of self-consistent (SC) type. The full-field simulations make use of a recently introduced technique, based on Fast Fourier Transforms (FFT), which allows obtaining the mechanical response of heterogeneous materials in a very efficient fashion. Results are shown for linear and power-law 2D and 3D polycrystals. For linear systems, the above comparison demonstrates the accuracy of the standard SC approximation, even for relatively large grain anisotropy, when the fluctuations become significant. On the other hand, of the various non-linear self-consistent formulations, the recent second-order method, which is based on a linearization scheme taking into account both the first and second order moments of the mechanical fields, gives the best overall agreement with the full-field simulations, for both the effective behavior and the statistical field fluctuations.

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