

MECHANICS OF POLYCRYSTALLINE AND HETEROGENEOUS MATERIALS AT DIFFERENT SCALES

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Virtually every solid material contains features that are different at different length scales. The challenge is to comprehend relationships between models at different length scales. This has led to a well-developed theory of “homogenization” mostly concentrating on the prediction of the effective response of heterogeneous materials. However emerging characterization methods in Experimental Mechanics, giving access to local fields at smaller and smaller scales, pose another challenge to modelers to devise efficient formulations that permit interpretation of the massive amount of data generated by these novel methods. Significant progress has been made in the last twenty years to model nonlinear heterogeneous materials which are made either from purely elastic or purely dissipative constituents. Emphasis is put here on the coupling between elastic and plastic effects. Incremental variational principles are exploited to propose approximate mean-field methods to predict accurately the overall response of heterogeneous materials as well as some of the statistics of the local fields.

Keywords: Heterogeneity; Plasticity; Field statistics;