MACROSCOPIC BEHAVIOR, MICROSTRUCTURE EVOLUTION AND IMPLICATIONS FOR STABILITY IN POROUS METALS

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This paper is concerned with porous material systems with viscoplastic constitutive behavior and random microstructures that may evolve in time as a consequence of the applied loading conditions. There are four principal themes that will be investigated in the context of these material systems: (i) macroscopic behavior, (ii) field statistics, (iii) microstructure evolution, and (iv) the possible development of instabilities. Some recently developed techniques for estimating the macroscopic behavior of nonlinear composites will be presented [1]. These homogenization methods follow from variational principles expressing the effective behavior of a nonlinear composite in terms of that of an optimally chosen linear comparison composite. This construction allows the use of standard bounds and estimates (e.g., Hashin-Shtrikman, self-consistent) for linear materials to generate corresponding information for nonlinear composites. Comparisons will be made with available numerical simulations and experimental results, which show that the new estimates are significantly more accurate than earlier ones, especially when the nonlinearity and heterogeneity contrast of the phases is high. The methods can be extended to incorporate evolution of the microstructure and its influence on the effective response under finite strains, including implications for the possible development of macroscopic instabilities [2]. Some representative examples will be presented in the context of forming processes of porous materials [3].

References

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