Dilatational viscoplasticity of porous polycrystalline materials (*)

Ricardo A. Lebensohn (Los Alamos National Laboratory, USA)

Many engineering problems (e.g. dynamic loading of polycrystalline materials, forming aggregates with initial porosity, creep-induced pore growth) require the determination of how the microstructure and the type of mechanical loading influence the viscoplastic behavior of polycrystals with intergranular cavities. For tensile solicitations, the determination of the dilatational component of the strain-rate is critical, since the latter is directly connected with void growth and, eventually, with the ductile fracture of the material. In this study we present results of two complementary formulations, one mean-field approach based on second-order nonlinear homogenization [1, 2] and one full-field approach based on fast Fourier transforms (adapted from [3,4]) to study the influence of different microstructural features (e.g. overall porosity, void shape, texture of the material phase, single-crystal anisotropy etc) and type of loading (e.g. triaxiality) on the dilatational viscoplastic behavior of voided polycrystals.

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