Homogenization of steady-state creep of porous metals using three-dimensional microstructural reconstructions - DTU Orbit (08/11/2017)

Homogenization of steady-state creep of porous metals using three-dimensional microstructural reconstructions

The effective steady-state creep response of porous metals is studied by numerical homogenization and analytical modeling in this paper. The numerical homogenization is based on finite element models of three-dimensional microstructures directly reconstructed from tomographic images. The effects of model size, representativeness, and boundary conditions on the numerical results are investigated. Two analytical models for creep rate of porous bodies are derived by extending the Hashin-Shtrikman bound and the Ramakrishnan-Arunchalam model in linear elasticity to steady-state creep based on nonlinear homogenization. The numerical homogenization prediction and analytical models obtained in this work are compared against reported measurements and models. The relationship between creep rate and porosity computed by homogenization is found to be bounded by the Hodge-Dunand model and the Hashin-Shtrikman creep model, and closely matched by the Gibson-Ashby compression and the Ramakrishnan-Arunchalam creep models. [All rights reserved Elsevier].

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