New features of the dilatational response of porous polycrystal with insensitive matrix displaying tension-compression

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ABSTRACT

In this paper, the dilatational response of porous polycrystalline materials with pressure-insensitive matrix displaying strength differential (SD) effects is investigated. To this end, micromechanical finite-element (FE) analyses of three-dimensional unit cells are carried out. The matrix behavior is governed by the isotropic form of Cazacu et al. [1]criterion that accounts for SD effects through a material parameter k. Simulation results are presented for axisymmetric tensile loadings corresponding to fixed values of the stress triaxiality for the two possible values of the Lode parameter, μ_Σ. Irrespective of the stress triaxiality, it is shown that for materials for which the matrix tensile strength is larger than its compressive strength (k > 0), under tensile loadings corresponding at μ_Σ =1 the void growth rate is much faster than in the case of tensile loadings at $\mu_\Sigma = -1$. The opposite holds true for materials with matrix tensile strength lower than its compressive strength (k< 0). This drastic difference in porosity evolution is explained by the distribution of the local plastic strain and stresses, which are markedly different than in a von Mises material (i.e. no SD effects of the matrix). Moreover, it is shown that all those new features are captured by the analytical criterion developed by Cazacu and Stewart [2].

REFERENCES

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