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

Oana Cazacu*, J.L. Alves†

* Department of Mechanical and Aerospace Engineering, University of Florida/REEF
1350 N. Poquito Rd. Shalimar, Fl 32579
cazacu@reef.ufl.edu, www.mae.ufl.edu/

† J. L. Alves
CT2M -Department of Mechanical Engineering, University of Minho,
Campus de Azurem, 4800-058 Guimaraes, Portugal
jalves@dem.uminho.pt, www.ct2m.uminho.pt

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, \( \mu_3 \). 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 \( \mu_3 = 1 \) the void growth rate is much faster than in the case of tensile loadings at \( \mu_3 = -1 \). 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