Evolution of Lattice Orientation Heterogeneity in HCP Single Crystals Due to Void Growth

K. Kowalczyk-Gajewska and S. Virupakshi

Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland
E-mail: kkowalcz@ippt.pan.pl

Highly anisotropic solids, like magnesium alloys are known to suffer from low ductility and fracture toughness. Better understanding of void growth failure mechanism under the condition of locally constraint plastic deformation, related to insufficient number of easy slip systems and twinning activity, may reduce limitations hindering use of hcp alloys as structural elements. Recently, the unexpected effect of twin related reorientation was found in numerical simulations of the void growth, namely a strong decrease of its evolution rate under uniaxial c-axis loading as well as the creation of twin-matrix and twin-twin boundaries leading to complex shapes of evolving cavities. Using own finite element implementation of the crystal plasticity model with twinning [1] of non-porous medium the analysis of multiple factors influencing microstructure evolution and material ductility will be performed, including overall loading scheme, local crystal orientation, initial porosity, and in particular, twinning activity. The longterm goal of this research is the formulation of homogenized elastic-viscoplastic model of porous single crystal deforming by slip and twinning, in which the micro-macro transition scheme is based on the sequential linearization method [2].

References

[1] Frydrych, K., Maj, M., Urbański, L., Kowalczyk-Gajewska, K., Twinning-induced anisotropy of mechanical response of AZ31B extruded rods, *Mater. Sci. Engng.: A* 771, 138610 (2020).
[2] Kowalczyk-Gajewska, K., Petryk, H., Sequential linearization method for viscous / elastic heterogeneous materials, *Eur. J. Mech. Solids/A* 30, 650664 (2011).