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# A MICROMECHANICAL STUDY OF VOID NUCLEATION MECHANISMS IN ALUMINUM ALLOYS

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Accurate prediction of ductile material failure at the macroscale requires understanding of the micromechanisms of ductile damage, i.e., void nucleation, growth and coalescence. The present work focuses on void nucleation in aluminum alloys and investigates the possibility of using micromechanical simulations to calibrate void nucleation criteria. A recently developed framework [1] is used to study void nucleation at the microscale, which combines *in situ* Synchrotron Radiation Computed Laminography, Digital Volume Correlation, and Finite Element simulations with advanced meshing capabilities. This framework allows immersed microstructures subjected to realistic boundary conditions to be modeled [2].

Micromechanical simulations of an aluminum alloy are carried out, and the evolution of the stress state at each inclusion is followed. Nucleation by decohesion of the inclusion-matrix interface and nucleation by inclusion fracture are both taken into account in the simulations. The nucleation criterion for the decohesion mechanism is based on a threshold for the local normal stress at the interface. For the inclusion fracture mechanism, the nucleation criterion is based on a threshold for the volume-averaged first principal stress in the inclusion. Upper bound and lower bound are estimated for the stress measures employed in the nucleation criteria for each inclusion. The validity of these nucleation criteria is discussed after comparisons with the experimental images.

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