# COUPLED EXPERIMENTAL—COMPUTATIONAL ANALYSIS OF PLASTICITY AND FRACTURE IN ALUMINUM AT THE GRAIN SCALE

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**ABSTRACT** Mechanisms such as dislocation-mediated plasticity, damage nucleation, and crack propagation govern the local and global mechanical behavior of metallic materials. Understanding the interplay among these mechanisms, i.e. knowing whether they amplify or damp each other, is therefore an essential prerequisite for the design of improved damage-resistant alloys. Here we present a set of simulation studies conducted with a combined crystal plasticity—phase field fracture (Shanthraj et al. [2016]) approach dedicated to the investigation of such coupling effects. More precisely, crack initiation and propagation and plasticity in two different aluminum alloys have been investigated. The microstructure models—a single crystal with a complex-shaped inclusion (Wicke et al. [2016]) and a polycrystalline sample—were obtained from experimental measurements. To this end, X-ray computer tomography (micro-computed tomography, μ-CT) and electron backscatter diffraction (EBSD) experiments were carried out. The influence of pore shape and crystallographic orientation was systematically studied by (a) creating a reference model with simplified spherical void and (b) by assigning three different crystallographic orientations to the matrix material. The results show that crack initiation is dominated by the crystallographic orientation in the case of the simplified pore while the complex-shaped pore introduces stress peaks that dominate the fracture behavior (Diehl et al. [2017]). In conclusion, the study reveals how sensitive crack initiation and propagation react towards small changes of the microstructure. Employing models based on real microstructures is therefore imperative when developing guidelines for the design of damage-tolerant materials.

## REFERENCES:

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