Prediction of Void Growth using Gradient Enhanced Polycrystal Plasticity

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Abstract. The growth of existing voids in the microstructure is governed by the localized plastic deformation around their boundaries. These voids are initially around an order of magnitude smaller than the grain size of common metallic materials. Consequently, the plastic deformation around the void can be reasonably well approximated by the crystal plasticity finite modeling approach. On the other hand due to the intrinsic size scales involved, the gradient of the plastic strain will be very large which is known to result in generation of significant amounts of Geometrically Necessary Dislocations. These have a direct influence on the governing equations of plasticity and hence the growth process. Therefore, the proposed approach takes into account hardening based on dislocation densities which include the GNDs as a source of dislocations. The generation of GNDs is modeled using a gradient enhancement in the finite element simulation. The growth of voids are qualitatively compared to experimental results found in the literature.