6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

CONSTITUTIVE GRAIN BOUNDARY MODELING BASED ON AN EXTENDED ENERGY FLUX

A. PRAHS, T. BÖHLKE

Karlsruhe Institute of Technology (KIT)
Institute of Engineering Mechanics - Chair for Continuum Mechanics
Kaiserstraße 10, 76131, Karlsruhe, Germany
e-mail: andreas.prahs@kit.edu, e-mail: thomas.boehlke@kit.edu

Keywords: *Slip gradient crystal plasticity, Extended energy flux*

Microstructured materials exhibit a non-local mechanical behavior, e.g., the Hall-Petch effect, [1] and [2]. Regarding oligo- or polycrystals, grain boundaries (GB) impede the dislocation movement and thereby dominate the mechanical behavior. Classical continuum models are not capable of reproducing such size effects, since they do not possess an internal length scale. Extended continuum models, such as gradient plasticity theories, overcome this drawback by introducing an internal length scale, e.g., by means of a defect energy, e.g. [3]. Based on an extended energy flux associated to plastic slip rates and corresponding microstresses, a slip gradient crystal plasticity theory with respect to small deformations is presented. The grain boundary is modeled by means of a corresponding free energy, proposed by [4], accounting for the crystallographic orientation of adjacent grains as well as for the orientation of the grain boundary. Regarding single- and bi-slip, analytical, one-dimensional solutions for the plastic slip are discussed with respect to a homogeneous stress state in a bicrystal.

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