11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

# MODELING OF GRAIN BOUNDARY RESISTANCE IN A STRAIN GRADIENT CRYSTAL PLASTICITY MODEL

**E. Bayerschen*[1], S. Wulfinghoff[1,2] and T. Böhlke[1,3]**

[1] Karlsruhe Institute of Technology, Institute for Engineering Mechanics, Chair for Continuum Mechanics, Kaiserstr. 10, Bldg. 10.23, 3. Floor, 76131 Karlsruhe, Germany,
www.itm.kit.edu/cm, eric.bayerschen@kit.edu
[2] stephan.wulfinghoff@kit.edu
[3]thomas.boehlke@kit.edu

**Key words:** *Grain boundary, Yield condition, Crystal plasticity, Elastic visco-plastic material, Size effect.*

Size effects are common phenomena observed in the plastic deformation of micro-specimen (see e.g. [1]). In this context, the resistance of grain boundaries against plastic flow is one important influence on the mechanical response [2].
One possibility to model such effects is the incorporation of a grain boundary yield criterion within a single-crystal strain gradient plasticity theory [3]. In addition, the gradient of an equivalent plastic strain is considered for a numerically efficient treatment of the theory. Finite Elements are used to implement the model at hand. The numerical results shown contain simulations with simplified grain aggregates under tensile loading conditions. Application of the theory to simulate the mechanical response of experimental data from the literature is presented.
Possible further refinement of the theory and application to a different load case is outlined.

## REFERENCES

[1] Yang, B., Motz, C., Rester, M., Dehm, G.: *Yield stress influenced by the ratio of wire diameter to grain size - a competition between the effects of specimen microstructure and dimension in micro-sized polycrystalline copper wires. Philosophical Magazine*, Vol. **92** (25-27), 3243–3256, 2012.

[2] Hirth, J.: *The influence of grain boundaries on mechanical properties. M*etallurgical and Materials Transactions B, Vol. **3** (12), 3047–3067, 1972.

[3] Wulfinghoff, S., Bayerschen, E., Böhlke, T.: *A gradient plasticity grain boundary yield theory. I*nternational Journal of Plasticity, Vol. **51**, 33-46, 2013.