INTERDISCIPLINARY CENTRE FOR
ADVANCED MATERIALS SIMULATION

The ICAMS Seminar presents

Prof. Dr. Bob Svendsen
Institute of Mechanics, Technical University of Dortmund

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Observation and initial modeling of deformation microstructures in FCC and BCC mesocrystals

As has been documented by many experimental investigations, sustained loading of polycrystalline metals results in deformation localization, deformation heterogeneity and deformation / dislocation-based microstructural development. This is particularly true at grain boundaries and triple-junctions in such systems, and leads to complex local stress-field variations driving further deformation-based microstructural development. Among other things, such processes affect the local lattice orientation and its distribution within grains and across their boundaries in the system. In the last few years, a number of studies (e.g. 1,2) have shown that experimental methods such as electron back-scattering diffraction (EBSD) and orientation imaging microscopy (OIM) can be used to determine crystal lattice orientation distributions on the sample surface as a function of position in the sample with resolution of 1 μm or better. Using these and related methods, one can determine in particular orientation gradients and relate these to lattice curvature. In turn, this curvature can be related in a model-dependent fashion to the density of geometrically-necessary dislocations (GNDs).

The purpose of the current work is the experimental characterization and initial modeling of the material and structural behavior in large-grained thin FCC and BCC sheet metal "mesocrystal" specimens subject to quasi-static loading. To this end, the development of deformation microstructure in such specimens has been characterized experimentally with the help of EBSD and other methods. On the modeling side, both standard crystal plasticity and its extension (e.g. 3) to include the effects of GNDs on the material and in particular on the hardening behaviour have been utilized and are being further developed. Modeling details and initial simulation results will be discussed.

1 V. Levkovitch, B. Svendsen. On the large-deformation and continuum-based formulation of models for extended crystal plasticity. *International Journal of Solids and Structures*, 43:7246–7267, 2006.
2 M. Henning, H. Vehoff. Local mechanical behavior and slip band formation of thin sheets with large grains, *Acta Materialia*, 53:1285–1292, 2005.
3 B. S. El-Dasher, B. L. Adams, A. D. Rollett. Viewpoint: experimental recovery of geometrically-necessary dislocation densityin polycrystals, *Scripta Materialia*, 48:141–145, 2003.