Vortrag

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Constitutive Models for Crystalline Materials Development and Applications

Three-level-constitutive models are generated for poly-crystalline materials with respect to grain center, near grain boundary and across grain boundary volume fractions. For the first level constitutive model SSDs are used as internal variables while for the second level SSDs and GNDs have to be considered at the same time. This is because non-uniform plastic deformations occur commonly which can cause non ignorable orientation gradients for a bulk material point in a small neighborhood and a certain number of additional dislocations have to be introduced to preserve the lattice continuity. Furthermore for the third level constitutive model interactions between mobile dislocations and grain boundaries have to be introduced by penetration energy and grain boundary elements. Aluminum bi-crystals with different mis-orientation are studied experimentally and numerically.

Furthermore the dislocation models have be extended to study superalloy creep. Account is taken of dislocation glide in the channels of the matrix of the face-centered cubic phase, dislocation deposit at the interfaces with the reinforcing L12 precipitates and the processes leading to cutting of them by dislocation ribbons *via* stacking fault shear of the <112> type. The novelty of this application lies in its treatment of <112> ribbons produced by the combination of <110> channel dislocations by an appropriate set of dislocation reactions. The model allows the following features of superalloy creep to be recovered: channel thickness and precipitate size dependence, lattice misfit, internal stress relaxation, incubation phenomena, and the inter-relationship of tertiary and primary creep, damage and vacancy accumulation, and possible driving force for rafts formation.

At last part of this presentation some concepts about future work are discussed.

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gez. Prof. Dr. rer. nat. Alexander Hartmaier

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