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Misorientation and grain boundary orientation dependent grain boundary response in polycrystalline plasticity. (English) [Zbl 1479.74021](#)
Comput. Mech. 67, No. 3, 937-954 (2021).

Summary: This paper studies the evolution of intergranular localization and stress concentration in three dimensional micron sized specimens through the Gurtin grain boundary model [*M. E. Gurtin, J. Mech. Phys. Solids* 56, No. 2, 640–662 (2008; [Zbl 1171.74314](#))] incorporated into a three dimensional higher-order strain gradient crystal plasticity framework [the first author et al., “Non-convex rate dependent strain gradient crystal plasticity and deformation patterning”, *Int. J. Solids Struct.* 49, No. 18, 2625–2636 (2012; [doi:10.1016/j.ijsolstr.2012.05.029](#))]. The study addresses continuum scale dislocation-grain boundary interactions where the effect of crystal orientation mismatch and grain boundary orientation are taken into account through the grain boundary model in polycrystalline metallic specimens. Due to the higher-order nature of the model, a mixed finite element formulation is used to discretize the problem in which both displacements and plastic slips are considered as primary variables. For the treatment of grain boundaries within the solution algorithm, an interface element is formulated and implemented together with the bulk plasticity model. The capabilities of the framework is demonstrated through 3D polycrystalline examples considering grain boundary conditions, grain boundary strength, the orientation distribution and the specimen size. A detailed grain boundary condition and stress concentration analysis is presented. The advantages and the disadvantages of the model is discussed in detail through numerical examples.

MSC:

- [74C20](#) Large-strain, rate-dependent theories of plasticity
- [74E15](#) Crystalline structure
- [74E20](#) Granularity
- [74M25](#) Micromechanics of solids
- [74S05](#) Finite element methods applied to problems in solid mechanics

Keywords:

[strain gradient plasticity](#); [microforming](#); [size effect](#); [Gurtin grain boundary model](#); [crystal plasticity](#); [mixed finite element simulation](#)

Software:

[UMAT](#); [ABAQUS](#)

Full Text: [DOI](#)

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