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Intragranular Kinematic Hardening Modelling and Validation

Maxime Sauzay

CEA Sacalay, Gif-Sur-Yvette, France

Various deformation induced dislocation microstructures often appear in deformed metals and alloys (cyclic/monotonic loading). Each is composed of a soft phase with a low dislocation density (cell interiors, channels) and a hard phase (dense walls). These dislocation microstructures induce backstresses, which give kinematic hardening on the specimen scale. A two-phase localization rule is applied in this paper for computing these intragranular backstresses. It is based on Eshelby's inclusion problem and the Berveiller-Zaoui approach. It takes into account an accommodation factor which permits the computation of reasonable backstress values for large plastic strains. This model is validated by comparing with a number of experimental backstress measures on single crystals. Despite the lack of an adjustable parameter, the agreement of the model with experiments is encouraging. Finally, the model is used for evaluating the division of polycrystal backstress into inter- and intragranular components and the results are compared with neutron diffraction measurements. This kind of physical intragranular kinematic hardening model could help to improve the prediction of polycrystalline homogeneization models.

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