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NUMERICAL SIMULATION OF DEFORMATION AND FRACTURE IN POLYCRYSTALLINE ALUMINUM AT DIFFERENT STRAIN SATES

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Based on the phenomenological physically-based model a viscoplastic constitutive equation has been developed for a three-dimensional case. Parameters of the thermomechanical model for aluminum alloy 6061-T6 are determined.

It is found that in the polycrystalline microstructure the local areas of plastic strain localization are formed at early stages of loading, when the homogeneous sample is still at the elastic stage of deformation. At the same time, at the developed stage of plastic flow, when the entire homogeneous sample experiences significant plastic strains, local regions of elastic strains are still observed in the polycrystalline sample. Accounting for the polycrystalline structure leads to lower values of the current yield stress in the macroscopic stress-strain curve.

At high strain rates there is a multiple cracking of the polycrystalline sample, while a single crack propagating perpendicular to the tension direction divides the sample into two parts at the strain rates lower than 100 s^{-1}. Volume fraction of the fractured material increases exponentially with the strain rate.

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