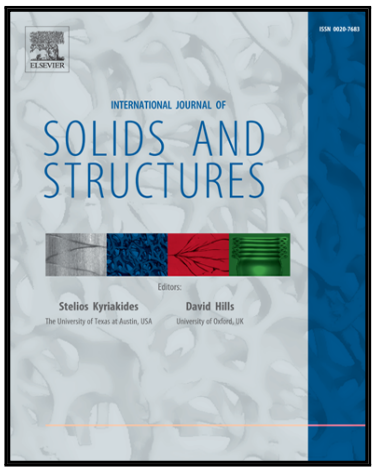

Effect of strain rate sensitivity in visco-plastic modeling

Adrien Chapuis , Qing Liu

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Effect of strain rate sensitivity in visco-plastic modeling

Adrien Chapuis*, Qing Liu

College of Materials Science and Engineering, Chongqing University, Chongqing 400044, P.R. China

* corresponding author: A. Chapuis, e-mail address: achapuis@cqu.edu.cn;

Abstract

Many crystal plasticity models use a rate sensitive law for its convenience. The rate sensitivity can be determined experimentally and input in the models. From a numerical point of view, high values of the strain rate sensitivity parameter *m* favor easy convergence of these models, but when *m* is fixed arbitrarily, which is in practice done for slightly rate sensitive materials, the physical meaning of *m* is lost. The present study shows that the flow stress σ, slip systems activity γ^s, strain anisotropy and simulated texture are strongly dependent on *m*. Precautions should be taken when predicting the mechanical behavior of polycrystals. To simulate nearly rate insensitive materials with models using a rate sensitive law, the use of the reference shear strain $\dot{\gamma}_0$ equal to the imposed strain rate is necessary but not sufficient. It is also necessary to use a high strain rate sensitivity parameter (*m*=0.05) to correctly evaluate the material parameters, i.e., the critical resolved shear stresses (CRSS). This study also provides a relationship between the CRSS determined for different values of strain rate $\dot{\varepsilon}$, *m* and $\dot{\gamma}_0$, so that CRSS determined in different studies can be compared.

Keywords: crystal plasticity; viscoplastic material.

Introduction

Strain rate sensitivity (SRS) is a material property that can be measured experimentally by different techniques. The strain rate sensitivity parameter *m* is defined by equation (1.1), in