Numerical analysis of PLC effect using large strain elasto-plasticity models

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ABSTRACT

Localized deformations can be triggered by material, geometrical or thermal softening forming stationary instability, e.g. neck or a shear band, or propagative instability like Lueders bands or Portevin–Le Chatelier (PLC) effect. PLC effect is characterized by serrated response in the stress-strain plot and it is attributed to dynamic strain aging. It is a dangerous phenomenon as it affects the yield stress, hardening rate (and thus material ductility) and ultimate tensile strength. The process is characteristic for metal alloys under certain strain rate and temperature conditions. It occurs for instance in steel and aluminium alloys. More information about the experimental characterization of the PLC effect can be found in [1, 2].

This work is focused on the numerical simulation of the PLC phenomenon using the large strain thermo-visco-plasticity model developed as an extension of the model proposed in [3]. A simple model with linear hardening and strain rate softening is confronted with a model of McCormic, motivated by micromechanical relations, see e.g. [4]. The influence of temperature and strain rate on simulation results is examined. The analysis is performed in AceGen and AceFEM numerical packages within Wolfram Mathematica [5]. Simple one- and two-dimensional tests are computed.

REFERENCES


