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ON A DISLOCATION-BASED CONSTITUTIVE MODEL AND DYNAMIC THERMOMECHANICAL CONSIDERATIONS

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ABSTRACT

Dislocation-based constitutive models are widely used to predict the plastic behavior of metallic materials, in both quasi-static and dynamic conditions. In addition, if the ratio of (adiabatic) thermomechanical (plastic work to heat) conversion is known, the stress-strain-temperature relationship can be estimated. The main purpose of this study was to verify the applicability of a widely-used expression (where the strain energy of a plastically deformed material is proportional to the density of dislocations) to calculate the stored energy in the material, which can be used in parallel with the micromechanical model to estimate the temperature rise during dynamic plastic deformation. An experimental campaign, where Kolsky (split Hopkinson) pressure bar tests were combined with *in situ* infrared temperature measurements, was conducted on OFHC copper compression specimens. The analytical thermomechanical conversion was compared with the experimental one, revealing *a significant discrepancy between the two*. An empirical *ad hoc* factor was introduced in the analytical expression in order to describe adequately the thermomechanical response of the material under dynamic (impact) loading conditions.

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