Adiabatic Shear Banding in Ductile Materials and Bulk Metallic Glass under Impact Loading

by

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Abstract

A numerical method has been developed for analyzing the one-dimensional strain-rate thermoviscoplastic deformation that results in multiple shear localizations (Zhou et al, *JMPS*, 2006, **54/5,** 904). In the current presentation, we apply this numerical scheme to study the adiabatic shear-banding in two different materials. Firstly, we study the multiple shear localizations in ductile materials with work-hardening. We show that a complete unstable thermoviscoplastic deformation process can be divided into an early stage of perturbation growth and an interaction stage between localizing bands. The results of the numerical simulations will be compared with the available theoretical estimations based on frozen coefficient perturbation analysis.

In the second study, we investigate the inhomogeneous flow and shear banding phenomenon in bulk metallic glass (BMG). Spaepen's free volume based flow theory (Spaepen, *Acta Metall*, 1977, **25**, 407) is employed for the analysis. The evolutions of plastic deformation, free volume concentrations, and temperature are solved in a coupled fashion. We shall that under impact loading, although the localization is triggered by free volume growth, the local temperature rise eventually accelerates the localization process and causes a stress collapse in the band. Material inertia and elastic energy release plays an important role in facilitating this localization process.