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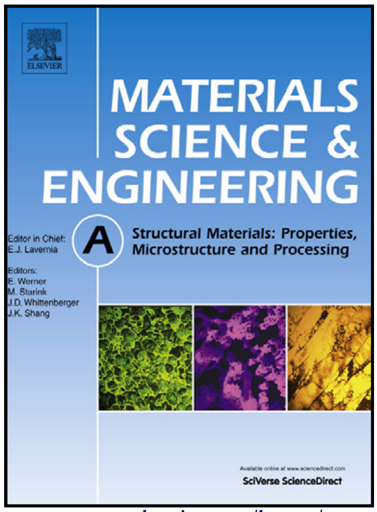

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Real time correlation between flow stress and dislocation density in steel during deformation

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ABSTRACT

We performed *in situ* compression of interstitial-free steel nanoblades in a transmission electron microscopy (TEM) in order to determine the relation between the evolution of the dislocation structures and the flow stress during deformation. In the early stage of deformation, the sample deforms elastically with a few dislocation motions. The dislocation multiplication processes have been discussed. Remarkable plastic softening with increasing dislocation density is observed after the maximum stress is reached, which can be understood as a situation in which the dislocation density is the dominant factor affecting the softening based on the Johnston-Gilman model.

Keywords: In situ nanoindentation; interstitial-free steel; plastic softening; dislocation; Johnston-Gilman model.

Introduction

The evolution of dislocation structures during plastic deformation is of great importance because of its relationship to the deformation mechanisms and mechanical properties of metals.