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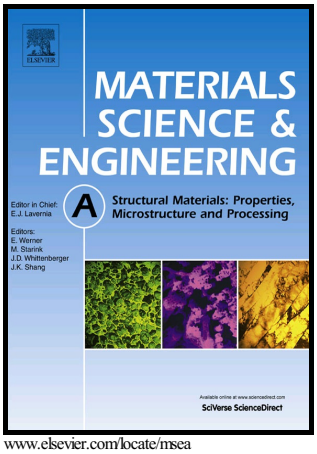

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Nanoindentation deformation of refine-grained AZ31 magnesium alloy: indentation size effect, pop-in effect and creep behavior

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Abstract

Nanoindentation tests were performed at room temperature, to study the coupling effects of grain size and strain rate on the indentation size effect (ISE), pop-in effect and creep behavior of refine-grained AZ31 alloys. The relatively inconspicuous ISE of the refine-grained AZ31 alloys compared with its coarse-grained (CG) counterpart is the result of more density of statistically stored dislocations involved in the plastic deformation. The gradually disappeared pop-in effects in the nanocrystalline (NC)/ultrafine-grained (UFG) AZ31 are associated with no/few deformation twinning involved in the plastic deformation. For the NC/UFG AZ31, the highly unstable dislocation absorption and interactions between dislocation and high-angle GBs are responsible for the primary and latter nanoindentation creep behaviors, respectively. While for the CG+twinning/CG AZ31, the relevant mechanisms are the relatively stable dislocation motion and interactions between dislocation and low-angle GBs.

Keyword: Indentation size effect; Pop-in effect; Nanoindentation creep behavior; dislocation motion; Grain boundary activities; deformation twinning.