Cell-structure and flow stress investigation of largely strained non-heat-treatable Al-alloys using dislocation based model

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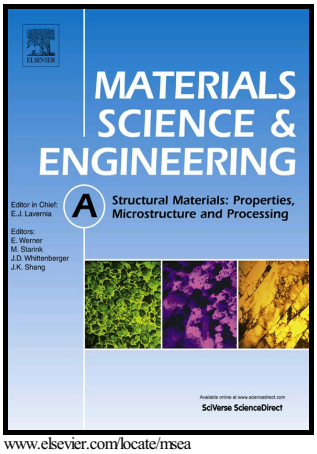

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Cell-structure and flow stress investigation of largely strained non-heat-treatable Al-alloys using dislocation based model

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Abstract

A severe plastic deformation is widely used to improve the mechanical properties of non-heat-treatable alloys. Thus, the investigation and modeling of microstructural evolutions of materials during large straining are of great importance. In this research, substructural evolutions of four different kinds of Al alloys namely Al-1Mn, Al-1Mg, Al-2.77Mg and Al-5Mg, have been studied using a dislocation based model and the mechanical properties of these alloys have been compared considering all microstructural parameters such as dislocation density, subgrain size, cell wall misorientation and the effect of alloying element. As a result, a simplified general equation has been expressed in order to predict the flow stress of aluminum alloys after large plastic deformation based on the influence of substructural parameters. Using this model, it is shown that magnesium is more effective to improve the strength of aluminum than manganese as an alloying element. In addition, due to higher SFE, Al-Mg alloys have more hardening rate with finer grains, accordingly.

Keywords: Substructural evolution; Non-heat-treatable aluminum alloys; Flow stress; Large strain