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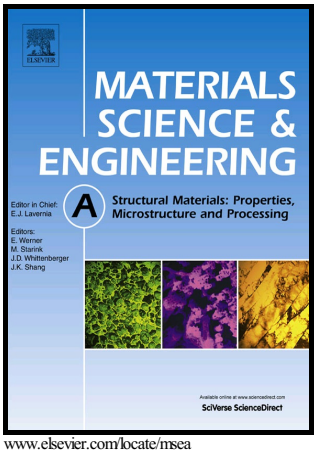


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# Superplasticity of ultrafine-grained Al-Mg-Sc-Zr alloy

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Abstract

The superplastic behavior of an Al–Mg–Sc–Zr alloy with a grain size of ~0.7 μm produced by equal channel angular pressing (ECAP) was examined in the temperature interval 150 – 500°C at strain rates ranging from $10^{-5}$ to $10^{-1}$ $s^{-1}$. No significant grain coarsening occurs under static annealing up to 450°C because of the strong pinning effect of $Al_3(Sc,Zr)$ dispersoids. The alloy showed superior ductility of 365 pct at 175°C, 1200 pct at 275°C and ~3300 pct at 450°C and strain rates of $1.4\times10^{-4}$ $s^{-1}$, $5.6\times10^{-3}$ $s^{-1}$ and $5.6\times10^{-1}$, with corresponding strain rate sensitivities of 0.3, 0.49 and 0.2, respectively. Analysis of the superplastic behavior in terms of threshold and surface observations showed that grain boundary sliding (GBS) controlled by grain boundary diffusion is the dominant deformation mechanism under all of the conditions. The strong pinning effect of coherent $Al_3(Sc,Zr)$ particles leads to a high dislocation density within grains after superplastic deformation that leads to initial strain hardening at low temperatures and high threshold stress. Analysis of the superplastic behavior showed that the strong temperature dependence of the threshold stress is most likely attributable to the interaction between dislocations and the coherent dispersoids, and the effect of temperature on the optimal strain rate of superplastic deformation associated with the highest values of elongation-to-failure is attributable to absorption of a lattice