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Effect of heat treatments on the microstructures and tensile properties of an ultrafine-grained Al-Zn-Mg alloy processed by ECAP

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Abstract

An investigation was conducted to determine the microstructures and tensile properties of an ultrafine-grained (UFG) Al-Zn-Mg alloy which was processed by equal-channel angular pressing (ECAP) for 1 and 4 passes at 423 K followed by heat treatments at 393 K for 5 or 20 h. Prior to ECAP, the Al alloy was in a T6 condition (solid solution treatment and peak aging) such that the precipitates introduced were able to hinder dislocation motions and enhance the grain refinement during ECAP. The results show that the yield strengths are enhanced but the ductilities are reduced after processing by ECAP for 1 and 4 passes but heat treatments at 393 K for up to 20 h are advantageous for improving both the yield strengths and the ductilities of the ECAP-processed alloy. The strength also increases with increasing holding time at 393 K from 5 to 20 h. A post-ECAP heat treatment improves the yield strength for the alloy after 1 pass of ECAP more effectively than after 4 passes. After post-ECAP heat treatments, precipitates containing GP zones, η' , η , T and E are distributed within the Al matrix. Large numbers of uniformly distributed nano-scale fine precipitates of η' , combined with ultra-fine grains and a high density of dislocations, contribute to produce an optimized balance between strength and ductility after ECAP for 1 pass and heat treatment at 393 K for 20 h.

Keywords: Al-Zn-Mg alloy; equal-channel angular pressing (ECAP); post-ECAP heat treatment; precipitates; tensile properties

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