Accepted Manuscript

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

Mohamed A. Afifi, Ying Chun Wang, Pedro Henrique R. Pereira, Yi Huang, Yangwei Wang, Xingwang Cheng, Shukui Li, Terence G. Langdon

PII: S0925-8388(18)31076-4

DOI: 10.1016/j.jallcom.2018.03.206

Reference: JALCOM 45436

To appear in: *Journal of Alloys and Compounds*

Received Date: 8 December 2017

Revised Date: 31 January 2018

Accepted Date: 15 March 2018

Please cite this article as: M.A. Afifi, Y.C. Wang, P.H.R. Pereira, Y. Huang, Y. Wang, X. Cheng, S. Li, T.G. Langdon, Effect of heat treatments on the microstructures and tensile properties of an ultrafine-grained Al-Zn-Mg alloy processed by ECAP, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.03.206.

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

Mohamed A. Afifi[a], Ying Chun Wang[a,b *], Pedro Henrique R. Pereira[c], Yi Huang[c], Yangwei Wang[a,b], Xingwang Cheng[a,b], Shukui Li[a,b], Terence G. Langdon[c]

[a]School of Materials Science and Engineering, Beijing Institute of Technology, Beijing 100081, China

[b]National Key Laboratory of Science and Technology on Materials under Shock and Impact, Beijing 100081, China

[c]Materials Research Group, Faculty of Engineering and the Environment, University of Southampton, SouthamptonSO17 1BJ, UK

*Corresponding author: Ying Chun Wang, e-mail: wangyc@bit.edu.cn; Tel: +861068913937 ext.801

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