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

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Mechanical properties of an Al-Zn-Mg alloy processed by ECAP and heat treatments

Mohamed A. Afifi[a], Ying Chun Wang[a,b *], Pedro Henrique R. Pereira[c,d], 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, Southampton SO17 1BJ, UK

[d] Department of Metallurgical and Materials Engineering, Universidade Federal de Minas Gerais, Belo Horizonte, MG 31270-901, Brazil

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

Abstract

An investigation was conducted to study the influence of equal-channel angular pressing (ECAP) and post-ECAP aging at 393 K for 20 h on the microstructures and tensile properties of a supersaturated Al-Zn-Mg alloy together with the effect of pre-ECAP heat treatments on the mechanical properties of the alloy after ECAP and after post-ECAP heat treatments. The results show that during ECAP processing for up to 4 passes for the supersaturated Al alloy there is a simultaneous occurrence of grain refinement, increases in the dislocation density and dynamic aging precipitation forming large numbers of fine spherical well-distributed precipitates which enhance the yield strength but decrease the ductility. During post-ECAP aging, there is a limited dislocation recovery with slight grain growth and the precipitate sizes increase together with the formation of a few larger platelet precipitates and the transformation of G.P. zones to η' and η' to η leading to a strength reduction after 4 passes of ECAP. The precipitates in the ECAP-processed alloy with pre-ECAP in the supersaturated state formed through dynamic aging precipitation are higher in their volume fraction, smaller in their size and more homogeneously distributed in the Al matrix than those in the alloy with pre-ECAP in the peak aging state which mainly come from the fragmented η' existing in the matrix before ECAP. The strengths of the alloy both after ECAP processing and after post-ECAP heat treatments with pre-ECAP in the supersaturation state are higher than with pre-ECAP in the peak aging state.

Keywords: Al-Zn-Mg alloy; equal-channel angular pressing; post-ECAP aging; pre-ECAP heat treatments; tensile testing