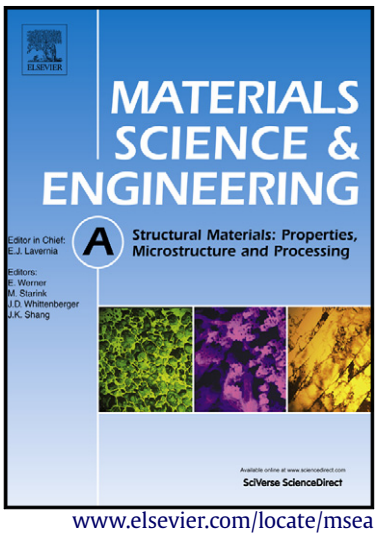

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PII: S0921-5093(15)00328-7
DOI: http://dx.doi.org/10.1016/j.msea.2015.03.077
Reference: MSA32174

To appear in: *Materials Science & Engineering A*

Received date: 10 March 2015
Revised date: 20 March 2015
Accepted date: 21 March 2015

Cite this article as: S.K. Shaha, F. Czerwinski, W. Kasprzak, J. Friedman, D.L. Chen, Effect of solidification rate and loading mode on deformation behavior of cast Al–si–Cu–Mg alloy with additions of transition metals, *Materials Science & Engineering A*, http://dx.doi.org/10.1016/j.msea.2015.03.077

Effect of solidification rate and loading mode on deformation behavior of cast Al–Si–Cu–Mg alloy with additions of transition metals

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Abstract

The Al□7Si□1Cu□0.5Mg (wt.%) alloy with micro□additions of Ti, V and Zr after varied solidification rates in as□cast and T6 heat treated states was subjected to monotonic tension, compression and cyclic deformations. The solidification rate affected the secondary dendrite arm spacing (SDAS), precipitate size which eventually control the flow stress during compression/tension and cyclic deformation. For the as□cast state, a reduction in the SDAS from 30 μm to 18 μm caused an increase of the ultimate strength from 354 MPa to 367 MPa and was accompanied by a slight reduction in the alloy deformability from 42.5% to 41.6%. For the T6 state, the strength increased from 413 MPa to 419 MPa and deformability reduced from 52.4% to 51.0%. The reduction of SDAS in the above range also caused a substantial increase in fatigue life. According to fractography, the tensile cracks propagated mainly through the eutectic Si and primary phases, exhibiting intergranular fracture along with some cleavage□like features through the plate□shaped Zr□Ti□V□rich intermetallics. The presence of fatigue striations on the plate□shaped intermetallics proved their ductile nature and had a positive effect on fatigue life. The EBSD analysis revealed differences in crystallographic texture and the contribution of dynamic recovery during deformation. The benefits of Zr□V□Ti additions in improving the alloy overall performance in automotive applications are discussed.

Keywords: Al□Si□Cu□Mg alloy, SDAS; EBSD map; cyclic deformation; fatigue striation.

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