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Impact of grain size on failure of AZ31 magnesium alloy

Seyed Hadi Mohamadi Azghandi[1], Matthias Weiss[1], Benedicta D Arhatari[2] and Matthew R Barnett[1]
[1]Deakin University, Australia
[2]La Trobe University, Australia

Magnesium alloys has attracted attention of automotive industries as a substitution to aluminium and steel sheet components due to its higher specific strength and specific bending stiffness. Grain refinement has shown promise to simultaneously enhance ductility and strength in magnesium alloys. Previous studies had mostly focused on strengthening mechanisms and processes in the initial stages of deformation, whereas the impact of grain size later during deformation has been largely ignored. In the present study, several techniques including optical microscopy, electron backscattered diffraction, energy dispersive X-ray spectroscopy, micro X-ray computed tomography and tensile testing equipped with GOM-ARAMIS system were employed to evaluate hot rolled AZ31 with six different grain sizes in terms of ductility and its relationship to failure behavior. Materials with similar basal texture and second-phase particles and average grain sizes 3, 7, 12, 22, 30 and 60 μm were examined. The improvement of failure strain with grain refinement is associated with altering void formation and reduction of twinning activity. Penny-shaped voids in the coarse-grained (60 μm) material change to mostly fine round-shaped ones in the fine-grained (3 μm) material. Rate of void nucleation shows insignificant change while rate of void growth markedly reduces with grain refinement. Reduction of twinning activity would decrease probability of damage developing at twin boundaries and increased grain boundary density would make hurdle to void growth.

Biography

Seyed Hadi Mohamadi Azghandi has received his MSc in Materials Science and Engineering from Ferdowsi University of Mashhad. He had worked in Sun-Air Research Institute of Ferdowsi University of Mashhad as a Research Engineer since 2011. He is currently a PhD candidate at Institute for Frontier Materials, Deakin University since 2015. His research interest focused on microstructure-mechanical properties relationships in ferrous and non-ferrous alloys.

shmohama@deakin.edu.au

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