World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:9, No:01, 2015

Enhancement of Mechanical Properties for Al-Mg-Si Alloy Using Equal Channel Angular Pressing

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Abstract : Equal channel angular pressing (ECAP) of commercial Al-Mg-Si alloy was conducted using two strain rates. The ECAP processing was conducted at room temperature and at 250 °C. Route A was adopted up to a total number of four passes in the present work. Structural evolution of the aluminum alloy discs was investigated before and after ECAP processing using optical microscopy (OM). Following ECAP, simple compression tests and Vicker's hardness were performed. OM micrographs showed that, the average grain size of the as-received Al-Mg-Si disc tends to be larger than the size of the ECAP processed discs. Moreover, significant difference in the grain morphologies of the as-received and processed discs was observed. Intensity of deformation was observed via the alignment of the Al-Mg-Si consolidated particles (grains) in the direction of shear, which increased with increasing the number of passes via ECAP. Increasing the number of passes up to 4 resulted in increasing the grains aspect ratio up to ~5. It was found that the pressing temperature has a significant influence on the microstructure, Hv-values, and compressive strength of the processed discs. Hardness measurements demonstrated that 1-pass resulted in increase of Hv-value by 42% compared to that of the as-received alloy. 4-passes of ECAP processing resulted in additional increase in the Hv-value. A similar trend was observed for the yield and compressive strength. Experimental data of the Hv-values demonstrated that there is a lack of any significant dependence on the processing strain rate.

Keywords : Al-Mg-Si alloy, equal channel angular pressing, grain refinement, severe plastic deformation
Conference Title : ICMSE 2015 : International Conference on Materials Science and Engineering
Conference Location : Paris, France
Conference Dates : January 23-24, 2015