Intergranular Corrosion behaviour of 6082 Al alloy: Effect of tiny concentrations of Cu and Zn

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Abstract Aluminium alloys are becoming more important for automotive today due to the need for light weight for E-vehicles. It is important to use recycled aluminium alloys because it is low energy intensive compared to virgin aluminium and less cost. Among various aluminium alloys, Al-Mg-Si alloys are the most frequently used family in engineering applications such as automotive, structural, aerospace, and marine. The presence of trace levels of Cu and Zn in the alloys due to contamination arising from the mixed post-consumer scrap has a great impact on Intergranular Corrosion (IGC) performance. In this work, effect of trace levels of Cu (0.001 – 0.05 wt.%) and Zn (0.003 – 0.06 wt.%) in 16 model alloys were investigated in detail by correlating intergranular corrosion behavior to microstructure. Intergranular corrosion level was investigated in an aqueous solution containing 10 ml/L concentrated hydrochloric acid and 30g/L NaCl for 24h. Methods such as Scanning Electron Microscope (SEM), Energy Dispersive Spectroscopy (EDS), Electron Backscatter Diffraction (EBSD), Scanning/Transmission Electron Microscopy (S/TEM), AFM/SKPFM, etc., are employed to study microstructure and the role of grain boundary precipitates and chemistry on IGC. Results obtained in this work are relevant in understanding the effect of trace levels of Cu and Zn, which is lower than the levels reported in the literature. Based on our TEM work, even trace levels of Cu and Zn down to 0.001 wt.% was enough to contribute to the IGC attack during accelerated testing, while balancing Cu and Zn in the alloy was found to reduce the IGC attack. Grain boundary misorientation angle showed considerable influence on the intergranular corrosion even with a tiny concentration of Cu (0.05wt.%). Results also revealed that a minor addition of Zn greatly influences the IGC.

Keywords Aluminium, Integranular corrosion, Copper, Zinc, Recycling