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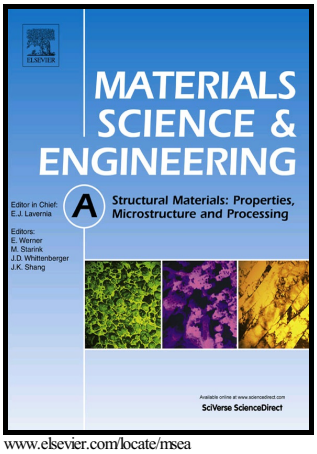

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Abstract

The rolling of an Al-3Mg-0.25Sc alloy at room and cryogenic temperature to 50 percent and 75 percent reduction in thickness resulted in the formation of a bimodal microstructure. The grain size distribution based on electron backscattered diffraction (EBSD) analyses showed an enhanced fraction of ultra-fine grains with nearly 100 nm in cryorolled samples whereas; room temperature rolled samples exhibited sub-micron grains with 300 nm. The transmission electron microscopy (TEM) studies revealed the dense dislocation cell structures for cryorolled samples due to the restriction of dynamic recovery. The better forming and fracture limit strains were noted for cryorolled samples compared to room temperature rolled ones in the forming and fracture limit diagrams. A good correlation of formability with void coalescence parameters based on larger void size, lower ligament thickness and lower *d*-factor were obtained. This indicated better accumulation of plastic deformation and improved formability of cryorolled samples. Further, the reduced aspect ratio (L/W) of void signified delayed fracture behaviour of cryorolled samples compared to room temperature rolled samples and showed better fracture resistance. The improved fracture limit strain in combined forming and fracture limit diagram exhibited by cryorolled samples was consistent with the void coalescence parameters.

Keywords: Cryorolling; Forming limit diagram; Void Coalescence; Fractography; TEM; SEM.