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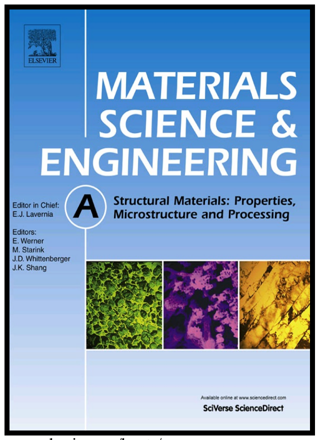

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Enhancing the strength and ductility in accumulative back extruded WE43 magnesium alloy through achieving bimodal grain size distribution and texture weakening

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Abstract

The microstructure of a rare earth containing magnesium alloy, Mg-4.35Y-3RE-0.36Zr wt.%, was engineered through applying accumulative back extrusion (ABE) process. Toward this end, the predetermined ABE cycles were applied at 400 °C up to five passes under a punch speed of 5 mm/min to study the ultrafine grained microstructure formation and its corresponding texture modification in the experimental material. A variety of bimodal grain size distributions were developed at all deformation conditions. In addition, the dissolution of eutectic phase stimulated the probability of dynamic precipitation of β phase during deformation. The latter caused a pinning effect on the grain boundary and gave rise to an inhomogeneous grain growth thereby intensified a bimodal grain size distribution (bimodality). In addition, the capability of experimental material to shear band formation during straining, even after one ABE pass, induced the level of bimodality. A remarkable grain refinement was achieved inside the shear bands due to the higher magnitude of shearing strain. Furthermore, the shear bands intersections provided suitable conditions for well defined ultrafine grain formation in between primary bands. The formation of noticeable number of these ultrafine grains within the shear bands could decrease the basal intensity thereby inducing a significant texture weakening effect. The obtained results indicated a significant improvement in both the strength (yield and ultimate) and elongation to fracture of the processed material. This was justified considering the effects of grain size, the level of bimodality and the texture weakening.

Keywords: *Magnesium alloy; Bimodality; Texture Weakening; Shear banding; Dynamic Dissolution; Dynamic precipitation*

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