"Rare Earth" texture effect on tension-compression yield asymmetry in binary Mg-Gd alloy by D-ECAP

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Abstract

Tension-compression (T-C) yield asymmetry is one of the issues that hinders the widespread application of wrought Mg alloys. Strong basal texture formed in thermomechanical processing and the difference in activation of deformation twinning in tension and compression are responsible for T-C asymmetry. To reduce the T-C asymmetry, a novel and simple implementable Double Equal Channel Angular Pressing (D-ECAP) is proposed in this study. Binary alloys of Mg-xGd (x=1, 5, 10 wt.%) bars with a diameter of 20 mm and length of 40 mm were subjected to D-ECAP at 400∘C. The average grain sizes were decreased from several hundred microns to about 13.4 μm, 5.7 μm, and 4.6 μm, for x=1, 5, 10 wt.%, respectively. All processed samples showed high tensile yield strength (TYS) and weak texture by adding Gd content. The texture results show that the so-called "Rare Earth" texture components from //ED to //ED were present in all samples and weak basal texture components, however, a new abnormal //ED named "C-texture" component was gradually formed in the Mg-10Gd sample. While the RE and C-texture components are favorable for the activation of {10-12} extension twins (ET) in tension along ED, twinning activity was heavily reduced because of the small grain size after severe plastic deformation. Therefore, the T-C asymmetry of Mg-10Gd diminished to the ratio of 0.9 between the compression yield strength (CYS) and TYS, without sacrificing the yield strength. The results of this study reveal that the new D-ECAP is an efficient processing technology that can be widely used in the preparation of high-performance Mg-RE alloys.

Keywords: Mg alloy, ECAP, RE texture, T, C asymmetry

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