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Hot tensile deformation behavior of Mg-Zn-Al magnesium alloy tubes processed by severe plastic deformation

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Abstract

In the current study, parallel tubular channel angular pressing (PTCAP), as a severe plastic deformation (SPD) method, was applied on a commercial pre extruded Mg-3Al-1Zn (AZ31) alloy tubes at 300°C to achieve a fine-grained (FG) structure. To study the deformation behavior, tensile testing at different temperatures of 25°C, 350°C, 400°C, and 450°C was done on the samples processed by multi-pass PTCAP. Also, the strain rate sensitivity exponent (*m*) is measured for the four-pass PTCAP processed tube, at 350°C, 400°C and 450°C and strain rates of 10^{-2}, 10^{-3} and 10^{-4} 1/s. The average value of *m* coefficients was ~ 0.3. A higher elongation to failure of ~ 281% was achieved at a higher temperature of 450°C and a lower strain rate of 10^{-4} 1/s, due to grain boundary sliding as a dominant deformation mechanism. After the first pass of PTCAP a bimodal microstructure, with large gains surrounded by many small ones, was observed. The grain refinement and homogeneity of the microstructure was enhanced by applying subsequent passes of PTCAP. Vickers microhardness measurements show that by more grain refinement caused by applying for more PTCAP passes, the value of hardness increased. Fractographic SEM images revealed that predominately ductile fracture occurred in all evaluated samples.