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Refining the microstructure, modifying the texture and enhancing the toughness of AZ31B alloy rod by the extrusion and upsetting

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Abstract: AZ31B alloy rods with a diameter of 35 mm were prepared by a novel severe plastic deformation method combined extrusion and upsetting (EU), and conventional direct extrusion (CDE), respectively. The microstructure and texture of the rods were investigated by optical microscopy (OM) and electron back-scatter diffraction (EBSD). Meanwhile, the hardness, tensile and compressive mechanical properties, and impact toughness were tested. The results show that the totally fine dynamically recrystallized (DRXed) grains are obtained for the EUed specimen. However the CDEed specimen exhibits a bimodal microstructure comprising coarse elongated hot-worked grains and fine DRXed grains. Both of the specimen exhibit strong texture, however the types of texture are completely different. The (0001) basal plane is parallel to the extrusion direction (ED) for the CDEed specimen, while it is perpendicular to the ED for the EUed specimen. And the change in texture strongly influences the yield strength of the alloys. Due to the grain refinement and texture modification, the EUed specimen exhibits much better ductility, where the elongation increases from 13.5% and 41.0% for the CDEed specimen to 26.0% and 106.0% at room and elevated temperatures. Meanwhile, the corresponding mechanical anisotropy decreases from 0.47 to 1.21. EU is an effective and simple method to refine the grain size, modify the texture and enhance the elongation to failure of wrought magnesium alloys.

Keywords: wrought magnesium alloy; extrusion and upsetting; grain refinement; texture

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