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Three-dimensional dendritic morphology and branching mechanism in directionally solidified Mg-Zn alloy

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ABSTRACT

The three-dimensional α-Mg dendritic morphology and branching mechanisms of directionally solidified Mg-Zn alloy were studied. Different microstructures were obtained under different pulling velocities various from 30μm/s to70μm/s. Directional growth tissue of α-Mg dendrite was obseved in the specimen solidified under the pulling velocity of 30μm/s, while in the samples solifdified in other pulling velocities α-Mg dendrites tend to exhibit equiaxed morphologies without any directional growth structure. Coupled with a novel method X-ray synchrotron tomography and trational metallographic technique, the three-dimensional morphology and topology structure of the α-Mg in the sample with the pulling velocity of 30μm/s were characterized. The result show that the morphology of α-Mg dendrites are diversity and complicated in three-dimensional space. Through the analysis we demonstrated that the α-Mg dendrite grows with seven secondary dendrite arms around the trunk which is different from what have been observed in the directionally solidified AZ91[1][2] and non-directional solidified Mg-Zn[3] or Mg-Al[4] alloys. In addition, the angles between the secondary dendrite arms and the trunck are different, with an angle of 53~54 ºfor three arms, 80~82 º for two and 60 º for the rest of the two arms. A hypothetical model of topological structure in α-Mg dendrites is proposed and the crystallography of the branches and advancing dendrite is discussed.

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