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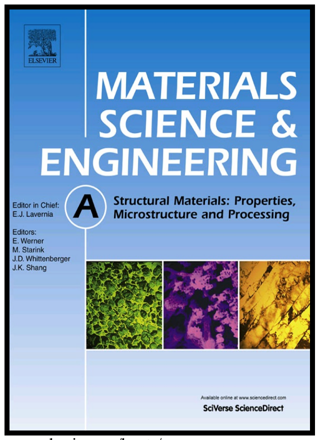

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High-temperature Tensile Properties and Deformation Mechanism of Polycrystalline Magnesium Alloys with Specifically Oriented Columnar Grain Structures

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ABSTRACT

A Mg–4.78Zn–0.45Y–0.10Zr (wt.%) alloy with specifically oriented columnar grain structures (crystal growth direction <01$\bar{1}$0>) was prepared using directional solidification. The columnar grain structures possessed parallel-growing primary arms and straight longitudinal grain boundaries. The results from an electron backscatter diffraction analysis demonstrated that the angle between the c-axis and the growth direction was 74–87°. As the tensile tests were performed along the <01$\bar{1}$0> growth direction, the Schmid factors for the <a> cylindrical and <c+a> conical plane slips were as high as 0.45. When the tensile test temperature was 300 ℃, dynamic recovery was observed and the <a> cylindrical, <a> conical, and <c+a> conical slip systems were all activated. This phenomenon, together with the high orientation consistency between the adjoining grains, resulted in an elongation increase up to 42%. Fractography of the Mg alloy revealed extended or parabola-shaped dimples with specifically oriented columnar grain structures, suggesting good ductility for this material.

Keywords: cellular dendrite; growth orientation; Schmid factor; <c+a> plane slip; high-temperature recovery

In order to exploit the benefits of magnesium alloys（higher specific strength, higher specific rigidity and better damping capacity）, two major ways are considered