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In-situ neutron diffraction study on compressive behavior of solution heat-treated Mg-Ca alloys at room and elevated temperature

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The addition of Ca to Mg can improve the creep resistance at elevated temperatures and the mechanical properties of Mg alloys at both room and high temperatures. In current study, the in-situ compressive deformation behaviors of solution treated Mg-0.5Zr and Mg-0.3Ca-0.5Zr alloy were investigated both at room and elevated temperature (~200℃) at STRESS-SPEC neutron diffractometer (MLZ, Garching). Calendric samples with 6 mm in diameter and 11 mm in length were compressed using a unique tensile/compression rig at STRESS-SPEC. Peak position and intensity variation with the compression strain were analyzed since they can indicate the evolution of lattice strain and preferred orientation, respectively. This will be related to the effect of Ca addition on the deformation modes of Mg alloys including basal slip, {10.2} twinning, prismatic slip and <c+a> pyramidal slip.
Results showed that the addition of Ca strengthened all the deformation modes at room and elevated temperature. However, the hardening effect of Ca on prismatic slip was more significant than that on the other deformation modes at room temperature. All the deformation modes were softened at 200 ℃, where prismatic slip and <c+a> slip got easier to be activated and basal slip carried more internal strain than that as room temperature. The alloy with Ca addition showed a better thermal stability at 200 ℃ due to the significantly strengthening effect of Ca solutes.

Keywords: Mg alloy, high temperature compression, in-situ, neutron diffraction

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