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Tensile Properties and Microstructure of Squeeze Cast Mg-Zn Alloys for Biodegradable Application

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Mg-Zn alloys have been demonstrated to be a good candidate for biodegradable applications. In the present work, Zinc (Zn) addition varying from 1.0 up to 10.0 wt. % was introduced into liquid magnesium. The alloyed liquid was squeeze cast under an applied pressure of 90 MPa. The results of mechanical testing on the squeeze cast Mg-Zn alloys shows that Zn is an effective additive for enhancing their mechanical properties, specifically, tensile and yield strengths at room temperature, but reducing the elongation. While the Zn addition rises from 1.0 to 10.0 wt.%, the ultimate tensile and yield strengths increases to 181.0 MPa and 105.0 MPa from 140.7 MPa and 39.3 MPa, while the elongation-to-failure (ef) decreases to 3.7% from 6.2%, respectively. The reveal of the as-cast grain structure by an optical microscope (OM) indicates that the high Zn content reduces grain sizes considerably. The microstructures analyzed by a scanning electron microscope (SEM) with the energy dispersive spectroscopy (EDS) show that the secondary MgZn phase forms once Zn is introduced in sufficient amount. The grain refinement and the massive presence of the secondary MgZn phase at the boundaries of the refined grains should be responsible to the enhancement of the strengths and the reduction in the elongation. The developed pressurized casting without employing secondary manufacturing processes such as extrusion or heat treatment exhibits its advantages to enhance the mechanical properties of the Mg alloys with high Zn content over conventional fabrication processes, since high Zn-containing Mg alloys have a long freezing range and tend to form microshrinkage porosity.