

APPLICATION OF THE CALPHAD APPROACH TO MG-ALLOYS DESIGN

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Mg alloys are highly attractive for engineering proposes thank to their high specific mechanical properties. The specific density of pure Mg ($\approx 1.74 \text{ g/cm}^3$) is 35% lower than that of Al ($\approx 2.7 \text{ g/cm}^3$), the reduction of engineering parts weight can result in reduced energy consumption and beneficial environmental implications. Currently, a relative small number of traditional Mg alloys are available. The possible benefits resulting from the application of Mg alloys motivated scientific and engineering interest in the development of new creep resistant Mg alloy for elevated temperature ($T > 200^\circ\text{C}$).

The development of a new alloy is governed by possible alloy constituents, composition, and processing parameters. Alloy development experiments are time and resource consuming. Computational thermochemistry based on the CALPHAD method can be utilized in development of alloys or optimization of materials dependent processes.

This work is aimed at the application of the CALPHAD method for development of new Mg-Al based creep resistant alloys. Several types of alloys were designed. The phases that are expected to form during equilibrium and non-equilibrium solidification were corroborated with detailed microstructural analysis results of microstructural stability test samples. Thermodynamics, X-ray diffraction and electron microscopy analysis indicate that the formation of $\gamma\text{-Mg}_{17}\text{Al}_{12}$, creep resistance deteriorating phase, is suppressed. The presence of different types of precipitates at the grain boundaries may serve as a source for grain boundary pinning and as obstacles for dislocation motion. Thus, the preliminary results suggest that the proposed alloys microstructure is stable to prolonged exposure at 200°C .