The importance of heat treatment of biomedical alloys from the Mg-Zn-Ca system

K.Kubok, L.Litynska-Dobrzynska, A. Wierzbicka – Miernik
Institute of Metallurgy and Materials Science Polish Academy of Sciences, Reymonta 25, 30-059 Kraków, Poland
kubok.katarzyna@gmail.com, l.litynska@imim.pl, wierzbickamiernik@gmail.com,

The interest in magnesium alloys from the Mg-Zn-Ca system has recently grown. In general, these types of alloys are designed for biomaterials and lightweight structure materials. However, before releasing the final product, all links between microstructure and mechanical properties should be known.

Alloys of nominal composition Mg-3Zn-xCa (x = 0, 0.5, 1.0) wt.% have been prepared by resistance melting and casting under the protective argon atmosphere. Solution treatment temperature has been designed according to the results from differential scanning calorimetry (DSC). Experiments has been performed to find a relationship between the age-hardening responses and corresponding microstructures in aim to optimize the composition as well as the heat treatment conditions. All specimens have been examined by hardness test during ageing at 200 °C. It has been shown that calcium addition causes the increase in hardness. A detailed characteristic of microstructure of metastable phases has been carried out at various stages of ageing using transmission electron microscopy (TEM) equipped with high-angle annular dark field-scanning transmission electron microscopy (HAADF-STEM). Calcium addition resulted in much refined and more homogeneous distribution of the precipitates when compared with the binary Mg-3%Zn alloy. The age-hardening of ternary alloy is attributed to the fine plates which are identified as a $Ca_2Mg_6Zn_3$ phase from electron diffraction analysis.