Effect of alloying element Ca and anodization on corrosion resistance and bioactivity of AZ61 alloy

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Magnesium and its alloys have attracted considerable attention as biodegradable implant materials owing to its ability to degrade by time without harming the host body environment. The main challenge of its application is the corrosion rates that is considerably high in physiological environment and thus threats its mechanical integrity. Addition of Ca as alloying element is known to improve the general corrosion resistance and mechanical integrity of magnesium alloys in chloride environment.[1] Note that Ca is a biocompatible element and naturally present in human bone. Ca enhanced the apatite forming ability of Magnesium during soaking in simulated body fluid (SBF)[2]. Surface coverage by apatite will further reduced dissolution of magnesium. Alloying concentration of Ca in Mg should be limited to 3 wt% as higher concentrations tend to disintegrate the alloys.[2] In this work, 2 wt% Ca was added in AZ61 alloys (6 wt% Al, 1 wt% Zn) and further improvement of corrosion resistance was evaluated by anodizing in 0.5 mol/dm^3 Na_3PO_4 solution at a constant current density of 200 A/m^2 at 20°C. The effect of anodizing time on the electrochemical corrosion behavior and bioactivity was investigated by polarization measurements in 0.9 wt% NaCl solution and in-vitro test in simulated body fluid (SBF), respectively, at 37°C. Potentiodynamic polarization results showed that Ca addition did not have significant effect on the corrosion resistance of AZ61 substrate. Anodizing in phosphate solution increased the corrosion resistance of both AZ61 and AZX612 significantly. The corrosion resistance increased with anodizing time probably due to increase in oxide uniformity. Note that sparking discharge occurred during anodization resulted in variation of oxide thickness. Apatite forming ability on anodic oxide was higher in the Ca containing alloy than in non-Ca alloy after 1 week immersion in SBF. Thinning of the oxide was also observed and apatite was formed preferentially on the remained thick oxide. Improvement of both corrosion resistance and bioactivity obtained in the Ca containing alloy promises its application as biodegradable implant material.

References

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