

Influence of hot rolling parameters on microstructure and biodegradability of Mg-1Ca alloy in simulated body fluid

Abstract:

Binary Mg-1Ca alloy has been considered as a potential material for implant applications due to its non-toxic and biodegradable properties. However, the high corrosion tendency of the alloy, as a serious drawback, limited its practical efficiency. In this study, the effect of hot rolling on biodegradability of Mg-1Ca was investigated as a process to improve the microstructure and corrosion resistance of the alloy in simulated body fluid. The as-cast alloy was rolled to various reduction levels at different temperatures. Optical and scanning electron microscopy together with energy dispersive X-ray spectroscopy and X-ray diffraction analysis were used to characterize the microstructure of the as-cast and rolled samples. Immersion and potentiodynamic polarization tests were performed to examine the electrochemical and corrosion behavior of the samples in simulated body fluid. The results showed that the high corrosion tendency of as-cast Mg-1Ca was remarkably reduced by the hot rolling process due to the microstructure refinement. It was found that the corrosion rate of the samples which experienced higher reduction percentages decreased to some extent. However, the weight loss results indicated that the rolling process at higher temperatures caused more corrosion products to emerge on the surface of the samples. It can be associated with the accumulation and growth of Mg₂Ca phase at the grain boundaries.