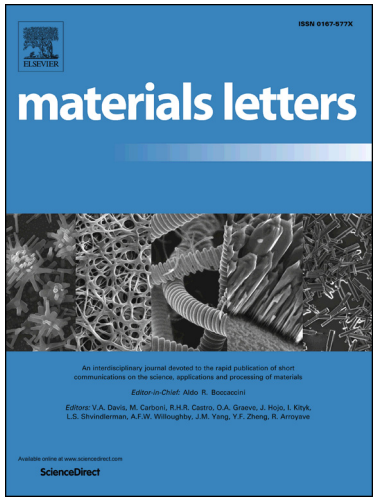

Improving corrosion behavior and *in-vitro* bioactivity of plasma electrolytic oxidized AZ91 magnesium alloy using calcium fluoride containing electrolyte

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Improving corrosion behavior and *in-vitro* bioactivity of plasma electrolytic oxidized AZ91 magnesium alloy using calcium fluoride containing electrolyte

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Abstract

Modified oxide layer was successfully prepared on AZ91 magnesium alloy by plasma electrolytic oxidation (PEO) using phosphate electrolyte containing calcium fluoride (CaF_2). Evaluating the corrosion behavior of the oxidized AZ91 magnesium alloy by potentiodynamic polarization in simulated body fluid (SBF) solution indicated that addition of CaF_2 to electrolyte leads to considerable decrease in corrosion rate caused by surface porosity, oxide layer thickness, and formation of MgF_2 phase. Electrochemical impedance spectroscopy (EIS) revealed that the resistance of the outer porous and the inner barrier parts of the oxide layer increased by 3 and 41 times, respectively. Presence of biological calcium ion along with fluorine and phosphorous ions in the oxide layer composition created a higher driving force for nucleation and growth of bioactive layer by decreasing the contact angle with SBF solution.

Keywords: plasma electrolytic oxidation, AZ91, CaF_2.

Introduction

Biodegradable magnesium alloys have been widely used in fabrication of biomedical orthopedic implants owing to their similar characteristics to natural bone. In order to create a strong connection to the bones and to prevent inflammation at the contact to the tissue, these implants should have a high corrosion resistance and bioactivity in physiological environment [1].

Plasma electrolytic oxidation (PEO) process is a novel method employed in surface modification of magnesium implants. In this process, an oxide layer is prepared as protector over the metal due to oxidation in electrolyte, the characteristics of which is affected by the electrolyte composition [2, 3]. The results of various studies have demonstrated that addition of fluorine ion to the electrolyte using potassium fluoride leads to improved corrosion and tribological behavior of PEO treated magnesium alloys [4, 5]. However, the toxicity of this precursor has limited its use specifically in environmentally friendly PEO process. Among the precursors