Effect of alcohols addition on the growth of PEO layer on AZ31 alloys and its corrosion performance for biomedical purposes

Isis Tournay-Dufrenne^a, L. Dangreau^b, M-G Olivier^{a,b}

^a Materials Science Department, Faculty of Engineering, University of Mons, 20, Place du Parc, Mons, Belgium

^b Materia Nova Research Centre, 3, Avenue N. Copernic, Parc Initialis, Mons,

Belgium

Abstract

Nowadays, many researchers are investigating different materials that could be used as resorbable implants to reduce the number of surgical procedures without weakening the bone. Magnesium alloys are of interest due to their good mechanical properties (e.g. modulus of elasticity close to that of bone), but their degradation rate due to corrosion is still considered too high, which could lead to the loss of mechanical integrity of the implant and its rapid failure. Therefore, a compromise between magnesium dissolution and sufficient lifetime is required. It is therefore interesting to develop layers with reinforced mechanical properties but also with porosity to promote osseointegration and to limit implant dissolution. This dual effect can be attained with plasma electrolytic oxidation (PEO) coatings which generally have a dense inner layer (to maintain strength) and a porous outer layer (to improve cell interaction).

A previous study showed that alcohols added in the electrolyte bath could improve the PEO layer performance. Therefore, a study mixing fluorides and alcohols in the electrolyte bath is carried out to investigate their effect on the properties of the PEO layer on AZ31 alloys. The different alcohols studied are ethanol, ethylene glycol and glycerol. The samples are analyzed in sodium chloride solution as well as in physiological electrolytes using Electrochemical Impedance Spectroscopy (EIS). The cross-section of the samples is characterized by Scanning Electron Microscopy (SEM) and micro-hardness studies.

Keywords: Plasma electrolytic oxidation; biomedical applications; alcohols; EIS; SEM.