

Corrosion behavior of Magnesium alloy WE 43 used in Biomedical Applications studied by electrochemical techniques

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Metallic materials including stainless steel, titanium alloys, and cobalt-based alloys constitute, due to their high strength, ductibility, and good corrosion resistance, an important class of materials in hard tissue replacement, especially load-bearing implants for the repair or replacement of diseased or damaged bones tissues. But, these metallic materials are not biodegradable in the human body, so a second surgical intervention may be necessary after the tissues have healed. Thus a strong body of research focuses on new biodegradable implants, which dissolves in biological environment after a certain time of functional use. Biodegradable implants constitute an appropriate solution because of cost, convenience and aesthetic reasons favorable to patients. Magnesium is one of the essential elements in the human body and has the advantage to be biodegradable [1]. So its corrosion performance can also be envisaged as potential applications for bioabsorbable stent implantology for cardiovascular diseases. Although excellent preliminary results have been achieved, absorbable metal stents (AMS) currently under clinical investigation [2] possess degradation kinetics and mechanical characteristics which are far from being completely optimized for all uses and applications.

The purpose of this study is to investigate the corrosion behaviors of pure magnesium and of a standard Mg-Y-RE WE43 alloys (untreated and anodized) in artificial body fluids. Because of potential use of Magnesium alloys and especially the WE43 for different types of implants, two types of physiology solutions were used, Artificial Plasma (AP) with high carbonate content and a buffered Simulated Blood Fluid (SBF). Due to solid-solution strengthening, the presence of yttrium in the WE43 should not only increase the creep resistance properties [3-5] but also the corrosion resistance, in addition to favourable high temperature properties. Then, the influence of the galvanostatic anodization treatment on the surface on the corrosion behavior was documented. Characterization of the oxide film structure and composition for optimized conditions was

performed by different electrochemical (EIS), optical, SEM, and Auger Electron Spectroscopy (AES) measurements. The investigations showed that SBF is significantly more aggressive than AP with regard to the untreated WE43 surface. The anodization process led to a formation of a thin hydroxide layer (few hundred nm) which increases the corrosion resistance of the alloy in both physiological solutions, especially in AP. The final objective is to modify the composition and / or the surface of the alloy with an anodic layer to obtain a suitable material with initial stability for an absorbable implant, followed after a couple of weeks by a full degradation of the implant.

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