Characterization of the microstructure and corrosion behavior of electrodeposited FeMn films for bioabsorbable implants applications

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Abstract

Corrosion of biodegradable implants is not supposed to be avoided, but controlled to reach a target biodegradation rate [1-4]. Implants made of Fe or its alloys have been studied for this type of applications; however, they have some drawbacks as low corrosion rates for this application, accumulation of bulky corrosion products and ferromagnetic properties, which might be a problem for MRI exams [1-4]. Some improvements have been proposed in the literature, such as using electrodeposition to produce thin strut walls of Fe (or alloys) with high purity and using FeMn alloys (with high concentrations of Mn) that can form an antiferromagnetic phase with higher corrosion rates than pure Fe [1-6].

In the first part of this work, thin films of FeMn alloys were electrodeposited from sulfate electrolytes. The effects of additives and electrodeposition current density were evaluated through electrochemical techniques. The microstructure of the electrodeposited films was characterized by SEM/EDX and XRD. The surface finishing and magnetic properties were evaluated by AFM/MFM techniques. The results showed that FeMn films with a maximum concentration of 18 wt% of Mn were obtained at an applied cathodic current density of 80 mA/cm^2 (close to the limiting current density) for a 1:5 ratio of Fe^{2+} and Mn^{2+} in the electrodeposition bath. These films were mainly composed of alfa-FeMn phase that still showed magnetic response on MFM analysis. The use of additives such as buffer, surfactant, and leveling resulted in a more homogenous film with improved surface finishing. In the second part of this work, the biodegradation rate of the electrodeposited film will be evaluated through immersion and electrochemical techniques in simulated body fluids.

References

1. **Y.F. Zheng, X.N. Gu, F. Witte**. Biodegradable metals. *Materials Science and Engineering R*. 2014, Vol. 77, pp. 1 - 34.