Corrosion behavior of Zn based alloys under inflammatory conditions

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Zn is a trace element that accomplish fundamental roles in diverse biochemical functions of the human body such as cell division, cell growth, wound healing, the breakdown of carbohydrates, the regulation of arterial blood pressure and, also it is crucial for the bone tissue growth and mineralization. The ideal amount of daily Zn in an adult human body is around 8-11 mg, in a lower quantity it can lead to a deficiency producing a greater risk of infection, loss of cognitive function, memory, and even behavioral problems [1,2]. The usage of Zn as a biodegradable material has started in recent years due to its promising biodegradability and adaptability to tissue regeneration [3].

This study aims to analyze the corrosion behavior of Zn alloys, particularly Zn-1Mg wt.% and Zn-1Mg-1Ag wt. % that were produced as cast ingots. The corrosion resistance was analyzed using both electrochemical and immersion tests in Hank balanced salt solution (HBSS), and in HBSS with 33 mM H_2O_2 addition to simulate inflammatory conditions. HBSS was adjusted to a pH of 7.4. The electrochemical tests were composed of registration of potential values under open circuit conditions (OCP), afterwards electrochemical impedance spectroscopy (EIS) and potentiodynamic tests were done. Immersion tests were performed to calculate corrosion rate in vitro and characterize corrosion damage formed on the surfaces. All tests were done at 37 °C.

The results clearly show that 1 wt.% of Ag addition increases corrosion resistance of the Zn alloys. After 1 hour of immersion Ag addition changed the corrosion mechanism, and surface of the samples with Ag addition were passivated in both analyzed medium. Regardless of the composition of the alloys, the locally formed corrosion damage was observed on the investigated materials.

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