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PII: S0257-8972(17)30630-8
DOI: doi: 10.1016/j.surfcoat.2017.06.027
Reference: SCT 22438

To appear in: *Surface & Coatings Technology*

Received date: 27 March 2017
Revised date: 18 May 2017
Accepted date: 12 June 2017

Please cite this article as: Rita Maurya, Abdul Rahim Siddiqui, Kantesh Balani , In vitro degradation and biomineralization ability of hydroxyapatite coated Mg-9Li-7Al-1Sn and Mg-9Li-5Al-3Sn-1Zn alloys, *Surface & Coatings Technology* (2017), doi: 10.1016/j.surfcoat.2017.06.027

In vitro Degradation and Biomineralization Ability of Hydroxyapatite Coated Mg-9Li-7Al-1Sn and Mg-9Li-5Al-3Sn-1Zn Alloys

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Abstract:

A biocompatible coating of hydroxyapatite (HA) has been deposited on novel Mg-9Li-7Al-1Sn (LAT971) and Mg-9Li-5Al-3Sn-1Zn (LATZ9531) alloys to control their corrosion and rapid degradation. HA coating was applied by a simple two-step conversion coating process, where phosphate conversion coating (PCC) is alkali treated to form HA coating. A ~ 34 μm and ~ 26 μm thick coating was observed on LAT971 and LATZ9531 alloys respectively and phase analysis conformed to be HA via X-ray diffraction technique. Potentiodynamic polarization test reveals that the coated LAT971 alloys showed the protection efficiency of ~96 % with the lower corrosion rate of 23 μm/y than the uncoated one (525 μm/y). The HA-coated LATZ9531 alloy showed the protection efficiency of ~ 12 % with a relatively lower corrosion rate of 567 μm/y than that of uncoated one (647 μm/y). Moreover, the polarization resistance of HA-coated LAT971 and LATZ9531 was measured to be ~ 113 times and 1.2 times of their uncoated alloys, respectively. Electrochemical impedance spectroscopy (EIS) results showed the lower degradation rate of HA-coated alloys with the higher charge transfer resistance for the coated LAT971 (3.9 MΩ.cm^2) and LATZ9531 (1.1 kΩ.cm^2) than that of uncoated one (686 Ω.cm^2 and 204 Ω.cm^2, respectively). Immersion test in simulated body fluid (SBF) revealed the too fast degradation of the uncoated alloys whereas HA-coated alloys showed a limited degradation with the biomineralization ability. Thus, the limited degradation and biomineralization ability of the HA-coated alloys meets the specific requirement for the biodegradable implants for load bearing applications.

Keywords: Mg-Li alloy; HA coating; Potentiodynamic polarization; Corrosion rate; Electrochemical impedance spectroscopy; Charge transfer resistance.

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