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***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 $\sim 34\ \mu\text{m}$ and $\sim 26\ \mu\text{m}$ 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 $\sim 96\%$ with the lower corrosion rate of $23\ \mu\text{m/y}$ than the uncoated one ($525\ \mu\text{m/y}$). The HA-coated LATZ9531 alloy showed the protection efficiency of $\sim 12\%$ with a relatively lower corrosion rate of $567\ \mu\text{m/y}$ than that of uncoated one ($647\ \mu\text{m/y}$). 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 ($3.9\ \text{M}\Omega\cdot\text{cm}^2$) and LATZ9531 ($1.1\ \text{k}\Omega\cdot\text{cm}^2$) than that of uncoated one ($686\ \Omega\cdot\text{cm}^2$ and $204\ \Omega\cdot\text{cm}^2$, 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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