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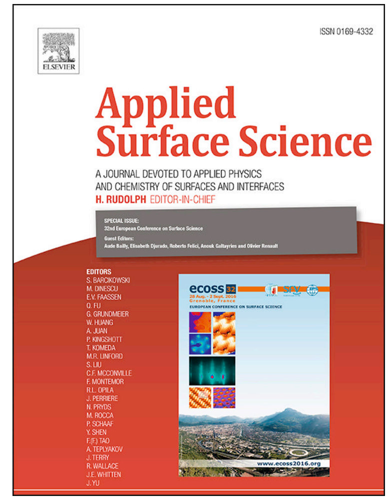

Full Length Article

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Biofunctionization of biodegradable magnesium alloy to improve the in vitro corrosion resistance and biocompatibility

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Abstract

Due to its superior mechanical and biodegradable properties, magnesium alloy shows great promise in medical devices such as cardiovascular stents and bone grafts. However, the rapid corrosion and the limited biocompatibility hinder its clinical applications. Because the corrosion and biocompatibility are closely related with the surface properties of biomaterials, a novel surface modification strategy was proposed in the present study. The magnesium alloy was firstly treated by NaOH to form a passive chemical conversion layer to improve the acute corrosion resistance, and then 16-Phosphonohexadecanoic acid (16-Pho) was introduced on the modified surface by the self-assembly approach. Poly (ethylene glycol) (PEG), fibronectin (Fn) and fibronectin/heparin (FH) were successively immobilized on the magnesium alloy (AZ31B) to improve the biocompatibility. Attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR) and x-ray photoelectron spectra (XPS) results showed that the above molecules were successfully immobilized on the surface. The hydrophlicity and corrosion resistance were significantly improved by alkali heat treatment. Decreased trend of water contact angle and better corrosion resistance were clearly observed after the following immobilization of the molecules. The biocompatibility was also improved by the surface modifications. Alkali heat treatments gave rise to low hemolysis rate, less platelet adhesion and prolonged clotting time, and the following surface modification further improved the blood compatibility due to the inroduction of the different molecules. In addition, good cytocompatibility to endothelial cells was obtained after the surface modifications, especially, Fn and FH effectively enhanced cell attachment and growth. Therefore, this study may give clues to obtain desirable corrosion resistance and biocompatibility simultaneously on the magnesium alloys, which would expand their potential applications in biomaterials and biomedical devices, especially for cardiovascular biomaterials.

Key words: magnesium alloy, corrosion resistance, biomolecule, blood compatibility, cytocompatibility