World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:14, No:01, 2020

Biodegradable Magnesium Alloys with Addition of Rare Earth Elements for Biomedical Applications

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Abstract : Biodegradable metallic materials such as magnesium (Mg)-based alloys have attracted extensive interest for use as bone implant materials. However, the high biodegradation rate of existing Mg alloys in the physiological environment of human body leads to losing mechanical integrity before adequate bone healing and producing a large volume of hydrogen gas. Therefore, slowing down the biodegradation rate of Mg alloys is a critical task in developing new biodegradable Mg alloy implant materials. One of the most effective approaches to achieve this is to strategically design new Mg alloys with low biodegradation rate, excellent biocompatibility, and enhanced mechanical properties. Our research selected biocompatible and biofunctional alloying elements such as zirconium (Zr), strontium (Sr), and rare earth elements (REEs) to alloy Mg and has developed a new series of Mg-Zr-Sr-REEs alloys for biodegradable implant applications. Research results indicated that Sr and Zr additions could refine the grain size, decrease the biodegradation rate, and enhance the biological behaviors of the Mg alloys. The REE addition, such as holmium (Ho) and dysprosium (Dy) to Mg-Zr-Sr alloys resulted in enhanced mechanical strength and decreased biodegradation rate. In addition, Ho and Dy additions (≤ 5 wt.%) to Mg-Zr-Sr alloys led to enhancement of cell adhesion and proliferation of osteoblast cells on the Mg-Zr-Sr-Ho/Dy alloys.

Keywords : biocompatibility, magnesium, mechanical and biodegrade properties, rare earth elements
Conference Title : ICRB 2020 : International Conference on Resorbable Biomaterials
Conference Location : Bangkok, Thailand
Conference Dates : January 16-17, 2020