World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:14, No:11, 2020

Effect of Hot Extrusion on the Mechanical and Corrosion Properties of Mg-Zn-Ca and Mg-Zn-Ca-Mn Alloys for Medical Application

Authors : V. E. Bazhenov, A. V. Li, A. A. Komissarov, A. V. Koltygin, S. A. Tavolzhanskii, O. O. Voropaeva, A. M. Mukhametshina, A. A. Tokar, V. A. Bautin

Abstract : Magnesium-based alloys are considered as effective materials in the development of biodegradable implants. The magnesium alloys containing Mg, Zn, Ca as an alloying element are the subject of the particular interest. These elements are the nutrients for the human body, which provide their high biocompatibility. In this work, we investigated the effect of severe plastic deformation (SPD) on the mechanical and corrosion properties of Mg-Zn-Ca and Mg-Zn-Ca-Mn alloys containing from 2 to 4 wt.% Zn; 0.7 wt.% Ca and up to 1 wt.% Mn. Hot extrusion was used as a method of intensive plastic deformation. The temperature of hot extrusion was set to 220 °C and 300 °C. Metallographic analysis after hot extrusion shows that the grain size in the studied alloys depends on the deformation temperature. The grain size for all of investigated alloys is in the range from 3 to 7 microns, and 3 μm corresponds to the extrusion temperature of 220 °C. Analysis of mechanical properties after extrusion shows that extrusion at a temperature of 220 °C and alloying with Mn increase the strength characteristics and decrease the ductility of studied alloys. A slight anisotropy of properties in the longitudinal and transverse directions was also observed. Measurements of corrosion properties revealed that the addition of Mn to Mg-Zn-Ca alloys reduces the corrosion rate. On the other hand, increasing the Zn content in alloys increases the corrosion rate. The extrusion temperature practically does not affect the corrosion rate. Acknowledgement: The authors gratefully acknowledge the financial support of the Ministry of Science and Higher Education of the Russian Federation in the framework of Increase Competitiveness Program of NUST «MISiS» (No K2-2019-008), implemented by a governmental decree dated 16th of March 2013, N 211.

Keywords : biocompatibility, hot extrusion, magnesium alloys, severe plastic deformation, properties

Conference Title : ICMMAB 2020 : International Conference on Multidisciplinary Materials and Advanced Biomaterials

Conference Location : London, United Kingdom

Conference Dates : November 19-20, 2020