Mechanical properties and dilatation performance of magnesium alloy (WE43) for vascular stents application after room temperature ECAP processing

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Abstract

During last years, one of the most important achievements in the area of the interventional cardiology in treatment of the ischemic heart disease is employment of the vascular implants, called stents. Owing to remarkable mechanical properties and biocompatibility of WE43 magnesium based alloy, it could be used in vascular stents and for this purpose improving strength of the alloy is necessary. This research is aimed at increasing the strength by severe plastic deformation using core-sheath ECAP method at room temperature. In order to improve the formability of the alloy, solution annealing treatment at 525 ℃ for 8 hours was conducted that resulted in minimum hardness and precipitate volume fraction with respect to as-extruded alloy. Severe plastic deformation of alloy at room temperature was performed by ECAP in 1 pass. The angle Φ between two intersecting channels and the corner angle Ψ of the ECAP die were 90 ° and 20 °, respectively. The ultimate tensile strength (UTS) and yield strength (YS) of ECAP-processed alloy was increased to 374 and 276 MPa, respectively. However strain to fracture decreased by 70% with respect to solution treated alloy. Furthermore, pattern of stent was designed using commercial AutoCAD software and then prototype stent was fabricated by Laser Cut. Simulation of Stent`s behaviour in contraction and expansion modes during implantation was done using commercial ABAQUS software. The characteristic presents changes of the outer diameter of the stent as a function of an expanding pressure. The Results revealed maximum shrinkage and dilatation of stent without fracture. Maximum shrinkage of 0.48 mm was obtained which was equivalent to 16% reduction of diameter and highest dilatation value was 0.67 mm equivalent to 22% increase in diameter.

*Keywords:* Magnesium based alloy, WE43, Severe plastic deformation, ECAP, vascular stent, Finite element method.