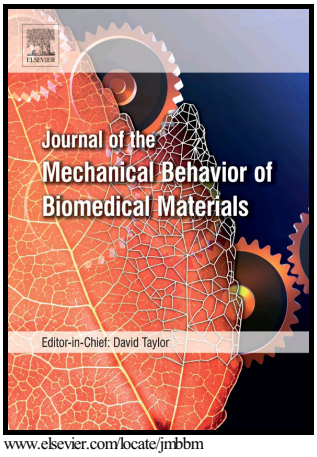

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Mechanical and Degradation Property Improvement in a Biocompatible Mg-Ca-Sr Alloy by Thermomechanical Processing

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Abstract:

Magnesium-based alloys have attracted interest as a potential material to comprise biomedical implants that are simultaneously high-strength and temporary, able to provide stabilization before degrading safely and being excreted by the human body. Many alloy systems have been evaluated, but this work reports on improved properties through hot extrusion of one promising alloy: Mg-1.0 wt.% Ca-0.5 wt.% Sr. This alloy has previously demonstrated intriguing toxicity and degradation properties in the as-cast and rolled conditions, and in the current study, extrusion results in a dramatic improvement in mechanical properties in tension and compression, as well as very low in vitro degradation rate. Microstructure (texture, second phase distribution, and grain size), bulk mechanical properties, flow behavior, degradation in simulated body fluid, and effect on osteoblast cyctotoxicity are evaluated and correlated to extrusion temperature. Maximum yield strength of 300 MPa (above that of annealed 316 stainless steel) with 10% elongation is observed, making this alloy competitive with existing implant materials.

Keywords: magnesium, strontium, biodegradable, reabsorbable, extrusion, implant

1. Introduction

Magnesium (Mg) alloys have attracted considerable attention as a biomedical implant material due to their potential to be absorbed safely in the body over time and their high strength compared to current polymeric absorbable materials [1–4]. This combination of properties would facilitate load-bearing implants that resorb over time in a wide array of indications. Such a material would be especially beneficial for patients with implants that can