MAGNESIUM BASED MATERIAL SYSTEM FOR ORTHOPAEDIC APPLICATION

A DISSERTATION

Submitted in partial fulfilment of the

requirements for the award of the degree

of

MASTER OF TECHNOLOGY

in

METALLURGICAL AND MATERIALS ENGINEERING

(With specialization in Materials Engineering)

By

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CANDIDATE'S DECLARATION

I hereby declare that the proposed work presented in this dissertation entitled **"Magnesium based material system for Orthopaedic Application"** is in partial fulfilment of the requirements for the award of the degree of **Master of Technology** in **Materials Engineering ,** submitted in the **Department of Metallurgical and Materials Engineering, Indian Institute of Technology Roorkee** is an authentic record of my own work carried out during the period of July 2015 to May 2016 under the supervision of **Dr. Debrupa Lahiri**, Assistant Professor, Department of Metallurgical and Materials Engineering, Indian Institute of Technology Roorkee, India.

The matter presented in this dissertation has not been submitted by me for the award of any other degree.

Dated:

Place: (Satish Jaiswal)

CERTIFICATE

This is to certify that the above statement made by the candidate is correct to the best of my knowledge and belief

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ABSTRACT

The development of biodegradable implants has grown into one of the important areas in medical science. It has fascinated researchers because of the importance in supporting tissue revival and healing, which generally occurs by degradation of the biodegradable implant material and taking up of the place by in-growing new tissue. Its degradability becomes more important for the accessories used to support fractured and damaged bones. Biodegradable accessories help in avoiding the requirement of revision surgery to remove those accessories after healing is complete. The biodegradable orthopaedic materials available in the current market are mainly made of polymers or ceramics. These orthopaedic accessories have an unsatisfactory mechanical strength when used for load-bearing parts. Magnesium and its alloys can be suitable candidate for this purpose due to their outstanding strength to weight ratio, biodegradability, non-toxicity and mechanical properties, similar to natural bone. The major drawback of magnesium is bioactivity and low corrosion resistance in the body, which also influences its mechanical and physical characteristics in service condition. In the present study, an effort has been taken to improve the corrosion resistance, bioactivity and mechanical strength of biodegradable magnesium alloys by synthesizing a Mg alloy matrix composite reinforced with different mass fraction of thermally treated hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$]. The composite is fabricated through powder consolidation route. All the powders were mixed thoroughly with the probe sonicator, cold-compacted and sintered at 550^0C. Morphologies, structure and density of the powders and sintered samples were characterized by X–ray diffraction, scanning electron microscopy and helium pycnometer. The in vitro bio–corrosion (biodegradability) and mechanical behaviours of samples are investigated by electrochemical and compression tests. The experimental results showed that addition of HA could slow down the corrosion rate and improve the mechanical properties of biodegradable magnesium alloy. These studies give an insight on the effect of HA reinforcement on corrosion resistant and mechanical behaviour of composite.
Keywords: Magnesium, Hydroxyapatite, Composite,