PREFACE

The development of metal-matrix composites with metal/metal alloy as matrix and reinforcement particles is an innovative approach for developing materials with better strength, corrosion resistance and high-temperature stability. One of the emerging areas of composite materials is their biological application and their usage as load bearing implant. Different materials have been developed in recent past that can be used as load bearing implant. Titanium and stainless steel are the most favorite permanent implant materials. The disadvantages of used titanium and stainless steel based implants are still unclear and it leads to development of biodegradable implant.

Magnesium (Mg) based biodegradable materials are a new generation orthopedic implant materials that are intended to possess similar mechanical properties as that of bone. Mg alloys are considered as promising substitutes to permanent implants due to their biodegradability in the physiological environment. However, rapid corrosion rate is one of the major constraints of using Mg alloys in clinical applications in spite of their excellent biocompatibility. Alloying method is one of the techniques to enhance mechanical and corrosion characteristics of magnesium based materials. Different alloying elements have been added to magnesium in order to improve its mechanical, corrosion and biological characteristics

The present study is focused on developing magnesium alloy based composite material reinforced by three different bioactive materials i.e. hydroxyapatite, S45P7 Bio Active Glass and 1393 Bio Active Glass. Here, the reinforcement particles added up to 10% were observed to enhance the mechanical, corrosion and biological characteristics and then the properties deteriorate after the optimized percentage of reinforcement. Also, to observe the biological characteristics of the composite prepared, the cell viability, growth inhibition, cytotoxicity assay and hemolysis assay tests were performed.

The magnesium alloy based composite prepared via powder metallurgy route were observed to have maximum strength and corrosion characteristics for the optimized composition Mg3Al2Zn0.6Ca10BAG. The results have shown that the reinforced particles HAp, 4575P7 BAG and 1393 BAG enhances the in vitro bioactivity of the composite as their concentration increases from 0%, 5 % and 10 %, 15 % and 20 %. But the mechanical and corrosion properties of the composites were increased up to 10 % (by weight) addition and further addition of these particles deteriorate the corrosion and mechanical characteristics compared to other composite with same base alloy. The composite Mg3Al2Zn0.6Ca10(1393)BAG were found to have hardness of 124.4 HV, young's modulus value 46.69 GPa, flexural strength of 128.89 MPa and compressive strength of 149.11 MPa. The potentiodynamic corrosion tests have shown that the initial corrosion rate of the samples were high, but as time passes the development of corrosion products on the surface prevented further degradation for all the compositions. The corrosion products developed on the surfaces were analyzed by SEM, EDS and XRD data and after 7 days there presence can be detected significantly and the main corrosion products were $Mg(OH)_2$ and hydroxyapatite $[Ca_{10}(PO_4)_6(OH)_2]$ in case of the composites added with 1393 BAG. Also, in case of Hap and 4575P7 BAG reinforced composites the corrosion products as observed from FTIR results were mainly formed by phosphate and carbonate bonds. The ion release estimation reveals that the magnesium ions released during dissolution were in the range of 10.642 ppm to 12.5452 ppm. The biological tests showed that Proliferation of K562 (human immortalized myelogenous leukemia) and DL (Dalton's lymphoma) cells were not significantly affected by the increasing amount of BAG in a concentration dependent manner as judged by 48 hours MTT assay. Similar to dividing tumor cells, the compounds were tolerant to blood lymphocytes and monocytes with minimum or no effect on viability and cytotoxicity. Therefore, the composites having composition Mg3Al2Zn0.6Ca10(1393)BAG were found to have optimized mechanical, corrosion and biological characteristics.