ABSTRACT

Materials play an important role in several biomedical applications and it is imperative that both the material and biological aspects are clearly understood for attaining a successful outcome. The materials that are used for structural applications in the field of medicine are known as biomaterials. These materials are used successfully to replace damaged or diseased parts in human or animals bodies. This field involves researchers from various disciplines such as materials science, applied science, engineering, medicine and hence it is highly multidisciplinary in nature.

Hydroxyapatite $[\text{Ca}_{10}(\text{PO}_4)_3(\text{OH})_2$, HAP] is one of the most effective biocompatible material and is found to be major component of the human bones and teeth. Nanostructured HAP exhibits much higher bioactivity than coarse crystal and resultant nanophase ceramics represent a promising class of orthopedic and dental implant applications with improved osseointegrative properties. Nanocrystalline hydroxyapatite can be synthesized by ultrasonic irradiation, sol-gel and co-precipitation, micro emulsion. Various coating technique are used to coat this HAP on the implant surface in order to have the biocompatibility with the host tissue and also to avoid the infections.

The main objectives of the present work are to be synthesis hydroxyapatite and fluorapatite in the nanorange without agglomeration; coating of HAP on various implants materials like commercially pure Titanium, Ti-6Al-4V and AISI316LSS; making bi-layer coating to improve the corrosion and wear properties; study the various mechanical behaviors of HAP coated implant materials and to find the anti-proliferative activity on HAP and Fluorapatite.

The first chapter gives brief introduction of biomaterials and its classifications; motivation of current research, nanoceramic coatings employed using plasma sprying technique.

The second chapter deals with synthesis of hydroxyapatite by various methods like sol-gel, co-precipitation and ultrasonic assisted co-precipitation technique. The synthesis of fluorapatite by ultrasonic assisted co-precipitation technique is also discussed in this chapter. The characterization studies on the synthesized hydroxyapatite and fluorapatite
characterized by FTIR, FT-Raman and XRD, scanning electron microscopy and transmission microscope, *in vitro* anti-proliferative activity on the HAP, fluorapatite are also added in this chapter.

Hydroxyapatite (HAP), Al$_2$O$_3$-13wt%TiO$_2$ (AT13), and AT13 over HAP were deposited on CP-Ti, Ti-6Al-4V and AISI316LSS implant surface using plasma spray coated technique. Plasma sprayed AT13 layer was acting as the foundation layer (thickness 75µm) to prevent the metal ions leach out from CP-Ti, Ti-6Al-4V and AISI316LSS implant surfaces and HAP as the top layer (thickness 75 µm), which was interacting with the human body tissues. The feedstock powders (HAP, AT13), HAP and AT13, bilayer (AT13/HAP) coated CP-Ti, Ti-6Al-4V and AISI316LSS surfaces were characterized in terms of XRD, SEM/(EDX), microhardness and surface roughness, adhesion strength. The corrosion, wear resistance and bioactivity were investigated in simulated body fluid (SBF) at 37°C respectively and the detailed discussions are made in the chapter 3, chapter 4 and chapter 5.

From the bilayer (AT13/HAP) coating improves wear resistance of CP-Ti, Ti-6Al-4V and AISI316LSS implant surfaces. The lowest wear rate and small wear track also observed bilayer coating compared to monolayer AT13 and HAP coating surface. The various conclusions obtained from the above four chapters are summarized in the final chapter.