SYNTHESIS OF HYDROXYAPATITE NANOMATERIALS FOR THEIR POTENTIAL USE IN FABRICATION OF BONE-IMPLANTS

W.P.S.L. Wijesinghe

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka

Recently, all over the world, hydroxyapatite (HA) nanomaterials and biocompatible prostheses coated by HA nanomaterials have widely been used in broad range of applications. However, current synthesis techniques of HA nanomaterials and preparation methods of HA coated bone implants (prostheses) are very expensive. Therefore, development of low cost and simple preparation methods for HA nanomaterials and bone implants have become one of the most important research areas in the globe. Furthermore, currently, bone implants and their raw-materials are imported to Sri Lanka with very high-costs. As a result, development of materials for bone-implants is very important for the reduction of medical expenses of Sri Lanka. This research work focuses on synthesis of HA nanoparticles and their nanocomposites using simple, novel and economical methods. This research work also attempts on development of thin-films of HA and TiO_2/HA on metallic implants through the Atomized Spray Pyrolysis (ASP) technique in order to produce biocompatible bone implants. Moreover, synthesis of HA nanoparticles dispersed PMMA matrix is introduced in order to replace expensive metallic biomaterials in medical applications.

In order to prepare HA nanoparticles, simple and economical method is devised using calcium and orthophosphate. Since naturally occurring calcium carbonate minerals can be used to prepare calcium sucrate, HA nanoparticles can be synthesized from these minerals which is a great effort on high value-addition to these minerals. Both needle-like and spherical hydroxyapatite nanoparticles are synthesized with this method and the effect of synthetic temperature and calcination on morphology, crystallite size and crystallinity are studied. Triton X-100 is used to prepare HA colloids in order to control the aggregation of HA nano particles. A novel, simple and low-cost technique is devised to prepare hydroxyapatite coated titanium metal (TiM) implants. TiO_2/HA nanocomposites are synthesized and deposited on TiM and Ti_6Al_4V surfaces in order to produce TiO_2/HA coated implants. The HA/polymer nanocomposites such as HA/poly(methyl methacrylate) (HA/PMMA), HA/poly(acrylic acid) (HA/PAA) and HA/stearic acid (HA/SA) are synthesized under *in-situ* and *ex-situ* preparation methods with their respective monomers and polymers. While polymerization of MMA into PMMA, the HA/SA is dispersed in to the reaction medium in order to produce HA nanoparticles dispersed PMMA matrix. Porous HA is synthesized using calcium sucrate on nano-$CaCO_3$ templates to use in biomedical applications. Furthermore, Eppawala apatite (EPAP) was directly converted into high purity HA nanoparticles by removing F and Cl from EPAP. All these novel methods and products are important to reduce the production cost of the HA nanoparticles, HA composites and biocompatible prostheses in order to use in biomedical fields.