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Preparation and characterization of Hydroxyapatite - Poly(methyl methacrylate) Nanocomposite

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Nature has built extremely hard and tough bone, a natural nanocomposite, using soft and brittle ingredients. Collagen acts as a structural framework in which plate-like tiny crystals of hydroxyapatite (HAp) are embedded to strengthen the bone. The prime role of minerals (HAp) is to provide toughness and rigidity to the bone, whereas polymer (collagen) provides tensile strength and flexibility.

The global use of bone grafts in 2000 has been calculated to be about 1 million yearly. Bone grafts provide mechanical or structural support, fill defective gaps and enhance bone tissue formation. There are many advantages of using nanocomposites for bone grafting, such as larger surface area, high surface reactivity, relatively strong interfacial bonding, design flexibility, enhanced mechanical reliability.

Because of the biocompatibility and osteoconductive properties of HAp have made it desirable as an implant material. Hydroxyapatite nanoparticles can be dispersed in a biocompatible polymer matrix such as Poly(methyl methacrylate) (PMMA) to develop a nanocomposite.

In this communication we report the synthesis of HAp - PMMA nanocomposites. Formation of HAp nanoparticles was achieved by hydrothermal synthesis of HAp at 60 ^{o}C and pH 10-13 using two methods. In first method, $CaCl_2$, $Na_2HPO_4.12H_2O$ and citrilmethylammonium bromide (CTAB) were used and $Ca(OH)_2$, $NH_4H_2PO_4$ were used in the second method by maintaining Ca/P ratio at 1.67. For the synthesis of HAp-PMMA nanocomposite, synthesized nanosized HAp particles were dispersed in the polymer matrix while polymer was synthesized in-situ by radical polymerization using $K_2S_2O_8$ initiator at 80 ^{o}C.
The XRD patterns confirm the formation of HAp particles. According to the Debye-Scherrer equation the synthesized HAp particle size varies from 7 nm – 36 nm. The cationic surfactant (CTAB) concentration and also the hydrothermal treatment affect on the particle size. FT-IR, XRD, TGA and DSC techniques confirm the formation of HAp-PMMA nanocomposite. Incorporation of 25% of PMMA (by weight) to the HAp-PMMA nanocomposite could be observed in the TGA.

Keywords: Hydroxyapatite nanoparticles, Poly(methyl methacrylate), Nanocomposite

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