

## Morphogenesis of Hydroxyapatite Nanoparticles and Composites under Hydrothermal Conditions

Vamshi Krishna Akkunuru, Babita Baruwati, Rohit Kumar Rana, Sunkara V Manorama\*

Nanomaterials Laboratory, Indian Institute of Chemical Technology, Hyderabad, A.P, India-500007.

**Statement of Purpose:** Hydroxyapatite [HAP,  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ ] is one of the most important biocompatible materials<sup>1</sup> that has been widely used as a bone substitute material. However, HAP is limited in its use because of its brittleness as compared to natural bone<sup>2</sup>. Nano-HAP was synthesized in various morphologies like spindle, rod. To mimic the natural bone and improve mechanical properties composites of HAP nanoparticles with collagen and  $\text{TiO}_2$  nanoparticles have also been synthesized in situ respectively and characterized.

**Methods:** The materials used for the synthesis of Nano-HAP and its composites are Calcium Nitrate Tetrahydrate (Merck), Ortho Phosphoric acid (Loba Chemie), Titanium Tetra Chloride in Hydrochloric acid (Ranbaxy), Ammonia solution (Ranbaxy), Collagen from calf skin (Sigma) and Acetic acid glacial (Loba Chemie). Nanoparticles of HAP with controlled morphology and size distribution have been synthesized via hydrothermal method by controlling the reaction parameters like temperature and time without any additives. The reaction mixture was heated in a Teflon lined autoclave under auto generated pressure in an air tight system. Various morphologies were obtained by varying the reaction parameters like pH, reaction time and temperature. Composites with collagen and  $\text{TiO}_2$  were also synthesized by the same method.

**Results/Discussion:** The nanoparticles synthesized were characterized by X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Fourier Transform Infrared Spectroscopy (FTIR). The XRD pattern confirms that the HAP particles are crystalline in nature with crystallite size in nanometer range. The FTIR spectra confirm the various bonds present in HAP,  $\text{TiO}_2$  and Collagen.

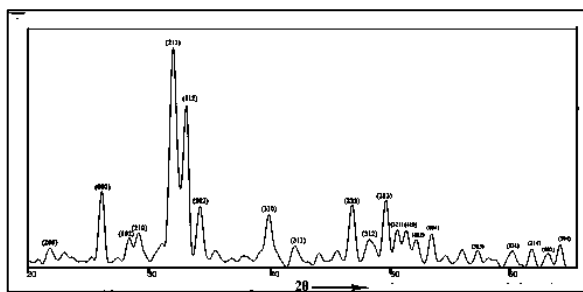


Figure 1. XRD pattern of HAP synthesized at 100°C with reaction time of 12 hour by hydrothermal method.

**Conclusions:** The crystallite size of Nano-HAP increased with an increase in the synthesis temperature, pH and reaction time. The Nano-HAP particles were in spindle shape at lower temperature whereas, they turned into rod shape with increase

in reaction temperature. HAP formed uniform composites with Collagen and  $\text{TiO}_2$ .

### References:

1. K. De Groot, "Bioceramics of Calcium Phosphate" (CRC Press, Boca Raton, Florida, 1983)
2. R. Z. Legeros, Clin. Mater.14, 65 (1983)