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Silica enhanced formation of hydroxyapatite nanocrystals in simulated body fluid (SBF) at 37 °C

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Abstract

The chemical modification of implant (prosthesis) surfaces is being investigated worldwide for improving the fixation of orthopaedic and dental implants. The main goal in this surface modification approach is to achieve a faster bone growth and chemical bonding of the implant to the newly generated and/or remodeled bone. In this work, we report fast formation of hexagonal nanocrystals of calcium hydroxyapatite (HA) in simulated body fluid (SBF, inorganic components of human blood plasma) solutions at 37 °C, using calcium phosphate (TCP) and sodium silicate as precursors. Characterization and chemical analysis of the synthesized powders were performed by Fourier transform infrared spectroscopy (FT-IR), X-ray powder diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The results indicated enhanced nucleation and formation of bone like layer of HA nanocrystals at the surface of TCP nanoparticles and occurrence of HA nanocrystals during 24 h soaking of TCP in SBF solution containing silica ions. The average size of a nanoparticle, using Scherrer formula, was found to be 18.2 nm.

Highlights

► We report on fast formation of hexagonal nanocrystals of calcium hydroxyapatite (HA) in silica-containing simulated body fluid solution at 37 °C. ► Bioactivity and biodegradability of TCP precursor have been confirmed by the dissolution of TCP and formation of a bone like layer of new HA nanoparticles outside of the precursor after 24 h soaking in SBF solution. ► Successive nucleation and formation of tiny hexagonal HA nanoplates and nanorods have been confirmed by TEM results after 24 h soaking of TCP in silica-containing BSF solution.

Keywords

Inorganic compounds; Chemical synthesis; Multilayer; Crystal growth; Electron microscopy