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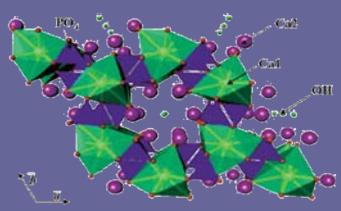
Preparation of Cobalt Substituted Hydroxyapatite Nanoparticles by Hydrothermal Treatment

Z. Stojanović, Lj. Veselinović, S. Marković, N. Ignjatović and D. Uskoković

Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Belgrade, Serbia

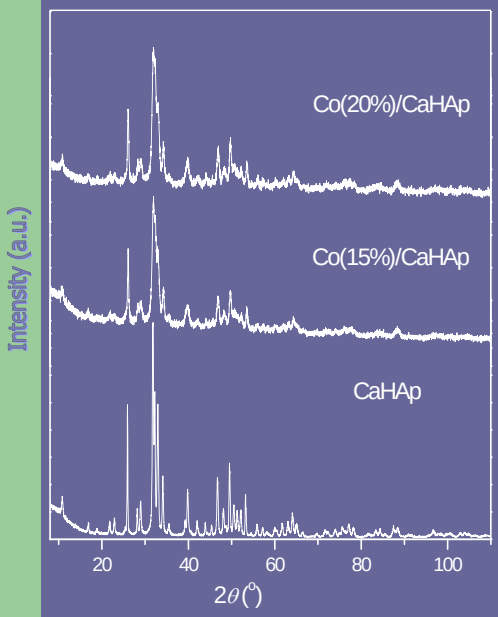
Introduction

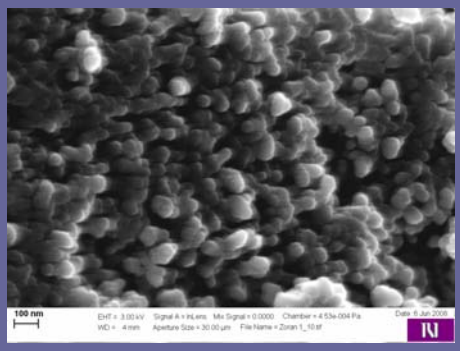
Calcium hydroxyapatite CaHAp ($Ca_{10}(PO_4)_6(OH)_2$) is the most bioactive and compatibile material widely used in medicine. Recently, some research grups have developed hydroxyapatite based magnetic nanoparticles with potential use for *hyperthermia* treatment and magnetic resonance imaging. Hydroxyapatite particles with magnetic properties can be obtained by substituting calcium ions Ca^{2+} with some metal ions like Fe^{3+}, Co^{2+}, Ni^{2+}. In this work, series of Co/CaHAp powder was prepared by hydrothermal treatment of precipitate. Crystal symmetry remained unaltered with addition of Co^{2+} ions.



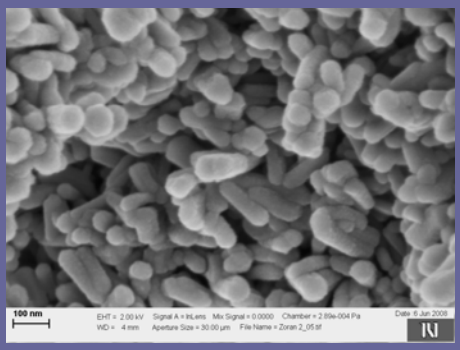
Preparation method

Saturated alkaline solution of $Ca(NO_3)_2$ and aqueous solution of $Co(NO_3)_2$ were simultaneously added dropwise in phosphoric acid solution on 50 °C, under constant stirring. The pH value of solutions was adjusted by adding proper amount of concentrated NH_4OH solution. About 1 l of this mixture, violet precipitate, was hydrothermaly treated on 200 °C and 2 MPa for 8 h in *Parr* stainless still stirring vessel. Ratio (Ca+Co)/P was fixed to 1.67 in starting solutions. After treatment vessel was quenched down to room temperature. Precipitates were washed with distilled water to remove potentially adsorbed Co^{2+} ions, and then centrifuged to separate CoO crystals from apatite, and dried on 90 °C in air for 24 h. Pure CaHAp precipitate was prepared using the same procedure.





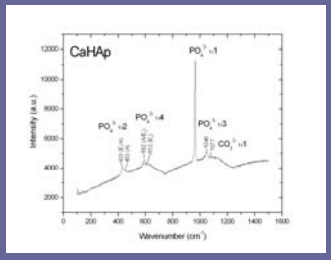
FE-SEM

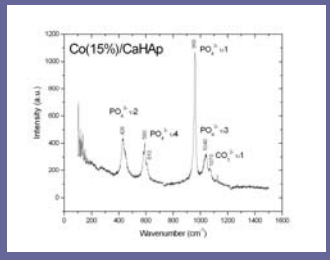


XRD measurements showed pure apatite phase in all samples. By increasing of cobalt amount in CaHAp samples diffraction maximums are shifted to larger angles, also, unit cell parameters decrease.

Sample	CaHAp	Co(15%)/CaHAp	Co(20%)/CaHAp
Lattice parameters [Å]	a = 9,4296 c = 6,8837	a = 9,421477 c = 6,851594	a = 9,419446 c = 6,851439
Cell volume [Å^3]	529,34	527,02	526,67
Mean crystallite size [nm]	41,45	15,37	14,23

Raman spectra





Conclusion

Hydrothermal treatment is an effective method for the preparation of cobalt-substituted hydroxyapatite (Co/CaHAp) nanoparticles. Data obtained by XRD and Raman spectroscopy show a change in the structure of HAp, which confirms that Ca^{2+} ions are substituted with Co^{2+} ions. SEM investigations revealed changes in particle size and morphology.

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