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Effect of Preparation Temperature on Crystal Structure and Magnetic Properties of Nanophase Fe-Substituted Hydroxyapatite

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Hydroxyapatite (HAp), Ca5(PO4)3OH, is the main mineral phase in physiological apatite (~70 wt% in bones and dentin, and ~96 wt% in enamel) is used in orthopedic and dentistry. Physical properties of HAp can be improved by introducing ionic substitutions in its structure. Fe is one of the minor substitution elements (0.01-0.1 wt% in bone, 0.003 wt% in enamel) replacing Ca in the HAp structure. It reduces the solubility of HAp therefore it functions as a cavities preventive agent. However, Fe overload may lead to a decreased mechanical strength and osteoporosis.

Two sets of Ca5-xFex(PO4)3OH samples (x=0,0.05,0.1,0.2,0.3) were synthesized by a chemical precipitation method at physiological temperature (37C) and 80C. The samples were calcinated at 650C and deuterated at 600C. The samples were characterized by powder x-ray diffraction (XRD) and SQUID Magnetometry. The Rietveld refinement method was used to analyze the crystallographic properties of the samples.

HAp was identified as the main phase in all samples while maghemite (γ-Fe2O3) was identified as secondary phase. Crystal structure parameters vary with the Fe content as well as with the preparation temperature. According to the magnetic measurements, sample with x=0 showed diamagnetic behavior while samples with Fe showed paramagnetic behavior. Preparation conditions considerably affect the crystal structure properties and magnetic properties of iron substituted HAp.