

Graduate Student Research Day 2014

Florida Atlantic University

CHARLES E. SCHMIDT COLLEGE OF SCIENCE

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

Vindu Kathriarachchi, Korey Sorge and Theodora Leventouri, Ph.D.

Charles E. Schmidt College of Science, Florida Atlantic University

The purpose of the study is to investigate the effect of preparation temperature on the crystal structure and magnetic properties of nanophase Fe-substituted Hydroxyapatite. Multi-substituted Hydroxyapatite (HAp), $\text{Ca}_5(\text{PO}_4)_3\text{OH}$, is the main mineral phase in physiological apatite, ~70 wt% in bones and dentin, and ~96 wt% in enamel. Iron is one of the minor substitution elements (0.01-0.1 wt% in bone and 0.003 wt% in enamel) replacing Ca in the HAp structure. Research interest on Fe-HAp is related to the fact that Fe for Ca substitution reduces the solubility of HAp therefore it functions as a cavities preventive agent. In contrast, Fe overload causes a decrease in bone mechanical strength. Furthermore, Fe-HAp can find applications in hyperthermia based anti-cancer treatments and in magnetic resonance imaging (MRI) contrast agents. Two sets of $\text{Ca}_{5-x}\text{Fe}_x(\text{PO}_4)_3\text{OH}$ samples ($x=0, 0.05, 0.1, 0.2, 0.3$) were synthesized by a chemical precipitation method at physiological temperature (370C) and 800C. The samples were calcinated at 6500C and deuterated at 6000C. The samples were characterized by x-ray powder diffraction (XRD), neutron powder diffraction (NPD) and SQUID Magnetometry. A single-phase system was detected for nominal iron content $x \leq 0.1$ by XRD phase identification in both sets of samples, while hematite ($\alpha\text{-Fe}_2\text{O}_3$) and/or maghemite ($\gamma\text{-Fe}_2\text{O}_3$) develops starting at $x=0.1$. According to the magnetic measurements, sample with $x=0$ showed diamagnetic behavior while samples with Fe showed paramagnetic behavior. Combined Rietveld refinements of XRD and NPD patterns will provide accurate information on the effect of processing temperature on the crystallographic parameters of the nano-materials.