Coupled substitutions of fluorapatite crystals in the engineering of optically-active bionanomaterials

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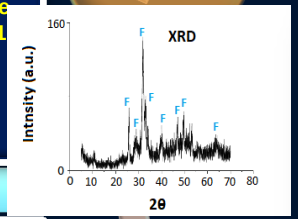
1. Introduction

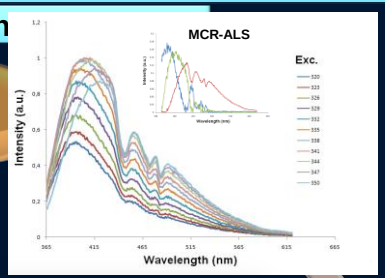
A wide range of new biomaterials for medical use has been prepared using various coupled ionic substitutions in a fluorapatite (FAp) crystal matrix [1-4]. FAp is present in human enamel, so its synthetic form is often used in the treatment of dental caries or osteoporosis [5]. In recent years, FAP nano-sized particles doped with rare-earth ions have been extensively studied as potential luminescent material for cell labeling, bone imaging in bone tissue engineering, and for cancer therapies [1-4]. Moreover, FAp is a suitable crystal matrix for various substituents that can alter its physicochemical, luminescent, and biological properties [5].

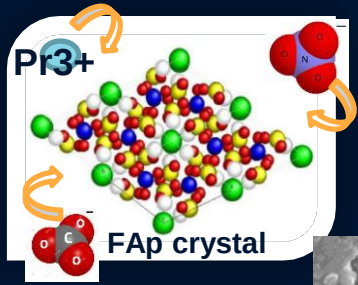
2. Methods

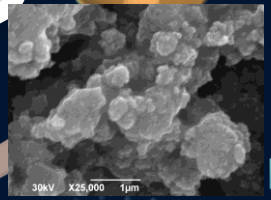
Uniform nanopowders of pure fluorapatite (FAp) and praseodymium-nitrate-carbonate substituted fluorapatite (PrNCFAp) have been successfully synthesized by precipitation reaction, and characterized by XRD, FTIR, SEM, TG and PL methods

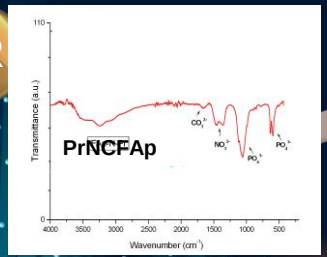
3. Characterization











4. Discussion and conclusions

Coupled substitution of FAp reduces the crystallite size, and FTIR spectra indicate the presence of nitrate (NO_3^{2-}) and carbonat (CO_3^{2-}) species. Structure thermally analysis confirm decomposition of water, NO_3^{2-} and CO_3^{2-} species in the range of 100-750 ^oC. Emission of FAp nanopowder occurred in the violet-blue region of visible part of the spectrum, with redshift to the green color region when Pr^{3+}, NO_3^{2-} and CO_3^{2-} substituted in the lattice. Analysis of luminescence spectra by MCR-ALS method extract three fluorophores from the samples and showed simultaneous existents of emission-reabsorption between dopants in FAp lattice. The obtained samples showed a small degree of hemolysis and antibacterial activity and could potentially be candidates for further research in dentistry.

References

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