SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

5th WORKSHOP: SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

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SYNTHESIS AND CHARACTERIZATION OF LUMINESCENT FLUORAPATITE NANOMATERIAL AS POTENTIAL DOSIMETER FOR FOOD IRRADIATION

D. V. Milojkov[1,2], J. Savić[1], J. Maletaškić[1], V. Živković-Radovanović[3], G. V. Janjić[4] and V. Stanić[1]

[1]*Vinča Institute of Nuclear Science, University of Belgrade, P. O. Box 522, 11001 Belgrade, Serbia. (d.v.milojkov@gmail.com)*
[2]*Faculty of Technology, University of Novi Sad, Bul. Cara Lazara 1, 21000 Novi Sad, Serbia.*
[3]*Faculty of Chemistry, University of Belgrade, P. O. Box 51, 11158 Belgrade, Serbia.*
[4]*ICTM, University of Belgrade, Njegoševa 12, 11000 Belgrade, Serbia.*

ABSTRACT

Inorganic luminescent nanomaterials on apatite basis are potentially attractive for application as dosimeter material. Nanostructure fluorapatite was synthesized by precipitation method at room temperature. Characterization was done by XRD, FTIR and SEM in order to confirm the nanostructure of monophase material. Material has luminescence in a violet region.

INTRODUCTION

Food irradiation, a technology of processing of food by ionizing radiation, extends the shelf life and improves the safety of foods [1]. This type of food processing can serve many purposes such as preservation, delay of sprouting and ripening, control of insects and pests, prevention of foodborne illness, and especially sterilization of food for illness patients and astronauts [2, 3]. It is of great importance for food irradiation to use a dosimetry and to develop new and better suited dose meter materials. Some studies are concerned to find a single dose meter, which will cover the full range of food irradiation from 10 Gy to 10 kGy [4]. In recent years, a synthesis, characterization and applicability of apatite based materials, such as fluorapatite and hydroxyapatite, as potential dosimeter materials in food irradiation, environmental protection and medicine, can be noticed [5, 6]. In this paper, a luminescent fluorapatite material, as potential dosimeter in many fields, was synthesized and characterized.

EXPERIMENTAL

Fluorapatite precipitate was prepared at room temperature by using $Ca(NO_3)_2 \cdot 4H_2O$, $(NH_4)_2HPO_4$ and $(NH_4)F$ of p.a. grade of purity. Starting atomic ratio Ca/P fixed at 1.67. First solution was prepared with dissolved required amount of $Ca(NO_3)_2 \cdot 4H_2O$ in 200 ml distilled water by stirring. A solution which contained required amount of $(NH_4)_2HPO_4$ and $(NH_4)F$ dissolved in 200 ml water was added dropwise to the first solution. Thereafter, a solution pH was adjusted to 10 by addition of NH_4OH and obtained suspension was mixed for following 16 h. The obtained precipitate was filtered and washed by distilled water, and then dried at 110 ^oC for 12 h. The resulting material is calcinated at fixed 1000 ^oC for 1 h and pulverized into powder.

X-ray diffractogram of powder was recorded by RaqukuUltima IV, Japan diffractometer. The FTIR spectra were recorded with Nicolet 6700 FTIR spectrometer (Thermo Scientific) using ATR technique. The morphology of powder was investigated by scanning electron microscopy SEM, JOEL JSM-6390LV. Diffuse reflectance spectra were recorded by Perkin Elmer Lambda 35 UV-VIS spectrophotometer, at room temperature. The fluorescence of powder was measured with photoluminescence spectrometer Horiba JovinYvon Fluoromax 4 TCSPC by excitation at different wavelengths at room temperature.

RESULTS AND DISCUSSION

The XRD diffractogram of powder is shown in Figure 1. All diffraction peaks can be assigned to synthetic fluoroapatite [JCPDS 83-0557], indicating that obtained phase of FAP is pure with high crystallinity.

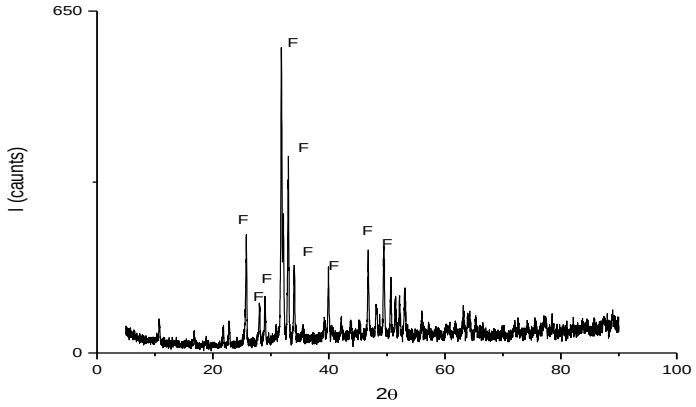

Figure 1. XRD difractogram of the nano-FAP powder.

The FTIR spectrum of nano-FAP powder is shown in Figure 2. The FTIR spectrum contains characteristic phosphate bands at 572 and 602 cm^{-1} (ν_2), and at 1037.2 and 1095 cm^{-1} (ν_3). Small band at 750.5 cm^{-1} arises from presence of fluor and oxygen in crystal lattice.

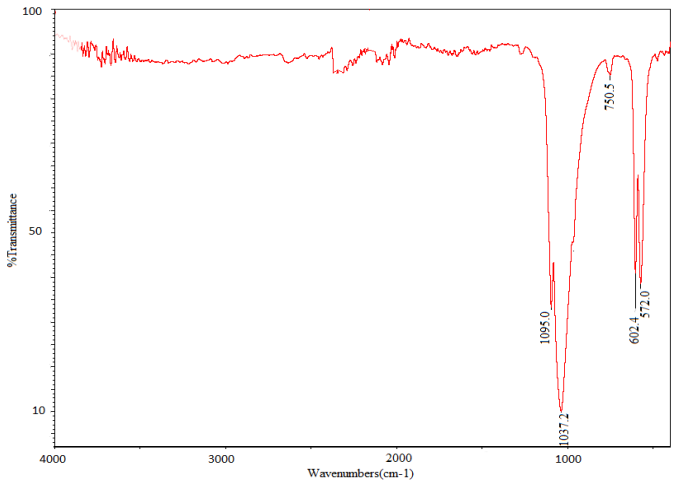

Figure 2. FTIR spectrum of the nano-FAP powder.

Micrographs of FAP powder are shown in Figure 3. Particles of FAP have nano size at about 100 nm, and easily form agglomerates of 1 and 2 μm.

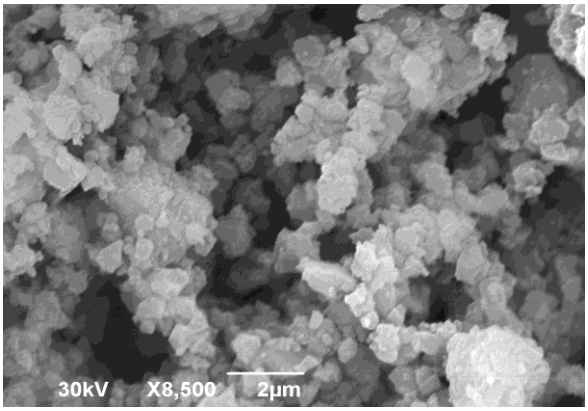

Figure 3. Micrographs of the nano-FAP powder.

Diffuse-reflectance and fluorescence spectra are presented in Figure 4. In diffuse-reflectance spectrum, the maximum of reflectance of 90% is noticed around 310 nm. In fluorescence spectrum, a peak is located in violet region of visible part of spectrum.

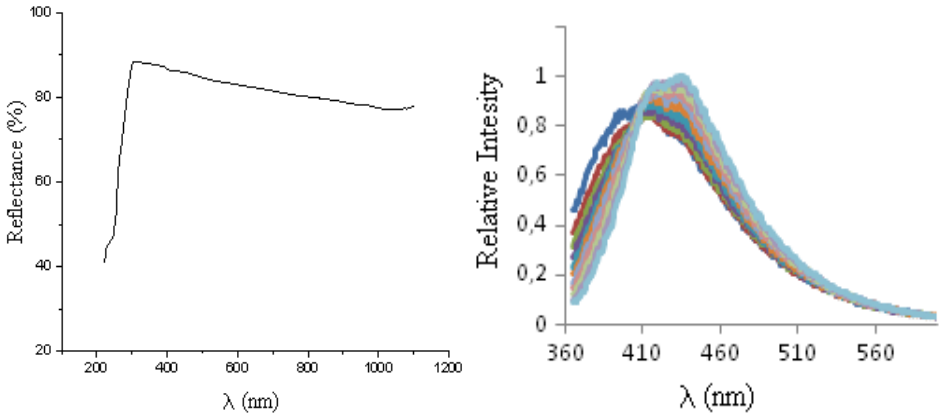

Figure 4. Diffuse-reflectance and fluorescence spectra of nano-FAP powder.

CONCLUSION

Luminescent nanostructure particles of FAP were synthesized by precipitation at low temperature condition. Obtained monophase nanomaterial is of high crystallinity, with fluorescence in a violet region.

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REFERENCES

[1] Radiation processing dosimetry-past, present and future, Techniques for high dose dosimetry in industry, agriculture and medicine, IAEA,Vienna, 1999, 3-10.

[2] J. Farkas, Irradiation for better foods, Trends in Food Science &Technology, 2006, **17**, 148-152.

[3] Dosimetry for food irradiation, Technical reports series No. 409, IAEA, Vienna, 2002, 9-31.

[4] D. A. E. Ehlermann, The Suitability of intrinsic and added materials as dose meters for radiation processing of particulate foods, Radiat. Phys. Chem.,1990, **36**(5), 609-612.

[5] M. Shafaei, F. Ziaie, D. Sardari, M. M. Larijani, Thermoluminescence properties of gamma irradiated nano-structure hydroxyapatite, Luminescence, 2016, **31**, 223–228.

[6] D. Lapraz, A.Baumer, Thermoluminescent properties of synthetic and natural fluorapatite, $Ca_5(PO_4)_3F$, physica status solidi,1983, **80**, 353–366.