SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

5th WORKSHOP: SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

September 27th, 2016, Belgrade, Serbia

is a satellite event of

PHYSICAL CHEMISTRY 2016

13th International Conference on Fundamental and Applied Aspects of Physical Chemistry

organized by

VINČA INSTITUTE OF NUCLEAR SCIENCES

Vinča – Belgrade, Serbia

in co-operation with

THE SOCIETY OF PHYSICAL CHEMISTS OF SERBIA

Held under the auspices of the

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT

Supported by

COST Action MP 1302 (Nanospectroscopy)

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Publisher
VINČA INSTITUTE OF NUCLEAR SCIENCES
Vinča - Belgrade, Serbia

Editor
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Reviewers
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Language editor and proof reader
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Design
Milica Ševkušić

Printed by
SLUŽBA ZA IZDAVAČKO-GRAFIČKU DELATNOST INSTITUTA ZA NUKLEARNE NAUKE VINČA

Print run
50 copies

ISBN
978-86-7306-133-7

BELGRADE, SERBIA 2016

P A7

SYNTHESIS AND CHARACTERIZATION OF FLUORAPATITE/POLYETHYLENE COMPOSITE

V. Stanić[1], K. Kalić[1,2], V. Živković-Radovanović[3], D. V. Milojkov[1,4], D. Topalović[1, 5], S. T. Tanasković[6] and S. Dimović[1]

[1]*Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia. (voyo@vinca.rs)*
[2]*Faculty of Physical Chemistry, University of Belgrade, University of Belgrade, P. O. Box 137, 11001 Belgrade, Serbia.*
[3]*Faculty of Chemistry, University of Belgrade, P.O. Box 51, 11158 Belgrade, Serbia.*
[4]*Faculty of Technology, University of Novi Sad, Bul. cara Lazara 1, 21000 Novi Sad, Serbia.*
[5]*School of Electrical Engineering, University of Belgrade, P.O. Box 35-54, 11120 Belgrade, Serbia.*
[6]*Faculty of Pharmacy, University of Belgrade, Vojvode Stepe 450, 11221 Belgrade, Serbia.*

ABSTRACT

In the present study, fluorapatite/polyethylene composite was prepared and characterized by means of different techniques (XRD and TEM). The effects of fluorapatite on the composite properties were investigated. It is found that the fluorapatite–polyethylene composite has an immiscible-intercalated structure.

INTRODUCTION

Polymer nanocomposites for food packaging materials are the subject of increased interest because of their unique properties that can have huge impact on food that is packed inside [1]. Polymers are considered as a good host material for inorganic and organic fillers. Active antimicrobial packaging is a promising form of active packaging that can kill, reduce or inhibit microorganism growth to improve the quality and extend the shelf-life of industrially produced food [2]. The incorporation of inorganic antimicrobial agents into a package might alter the mechanical and barrier properties of polymers. Fluorapatite (FAP) biomaterials showed potential antibacterial activity [3]. Several studies have shown that the cytotoxic, genotoxic and mutagenic effects of FAP materials have no effect or are negligible [4, 5].

Polyethylene packaging is relatively inexpensive to produce. High-density polyethylene (HDPE) is stiff, strong, tough, resistant to chemicals and moisture, permeable to gas, and easy to process and form. It is used to

make different bottles for liquid food and water, cereal box liners, margarine tubs-and grocery, trash, and retail bags.

EXPERIMENTAL

Synthesis of FAP powder was performed according to the neutralization method as described in the previous work. A high-density polyethylene (HDPE; HIPLEX HHM 5502, density: 0.955 g/cm^3) was purchased from Petrohemija a.d. Pančevo (Serbia) and used as composite polymer matrix.
The FAP/HDPE composite was processed in an intermeshing co-rotating twin-screw extruder. The extrusion process was carried out at a screw speed of 11.6 rpm and temperature profile of 170–210°C in the barrel.

The phase composition of synthesized composite was studied by X-ray diffractometry, XRD (Bruker D8 Advance Diffractometer), using Ni filtered Cu Kα1,2 radiation.

The morphology of the FAP/HDPE composite samples was analyzed using a Philips EM 208, Transmission Electron Microscope (TEM).

RESULTS AND DISCUSSION

The XRD pattern of FAP/HDPE sample is presented in Fig. 1. The sharp peak at 2 theta of 21.6° is characteristic for HDPE. This 2 theta value is in good agreement with the reported value of polyethylene [6]. The peaks at 2 theta of 31.52° and 33.0° indicating that FAP particles have been distributed to the HDPE matrix.

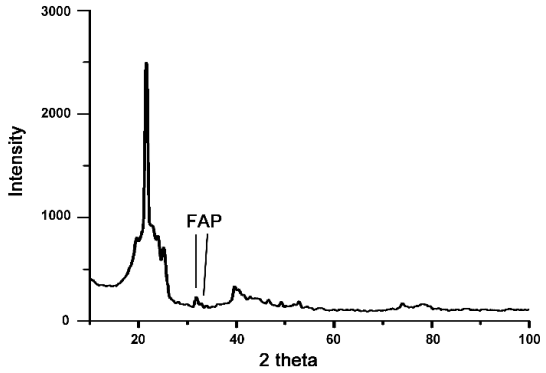

Figure 1. XRD pattern of synthesized FAP/HDPE composite.

The positions of its X-ray diffraction peaks were in accordance with ASTM data for fluorapatite (Card 15-0876). TEM is used in this work to study the dispersal of FAP nanoparticles in HDPE matrix.

Fig. 2 shows the morphology of FAP/HDPE sample. TEM image has shown that there are some individual nanoparticles of FAP scattered in the matrix, most of them are associated together in aggregates.

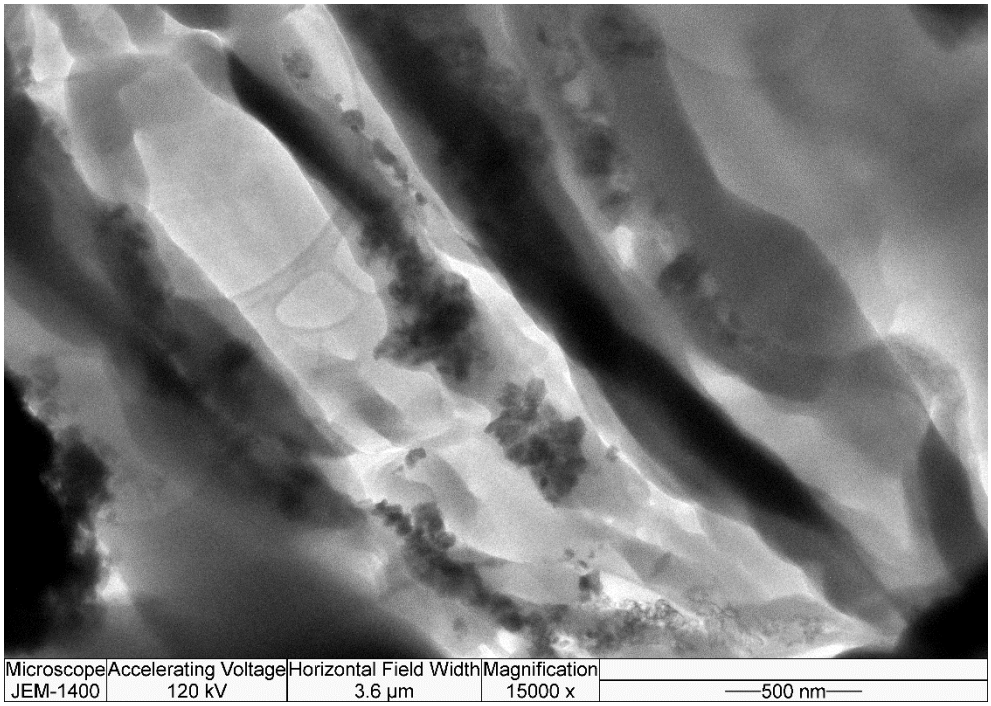

Figure 2. TEM micrograph of the synthesized FAP/HDPE composite.

The dispersion of inorganic/organic particles in the PE matrix depends on the molecular weight of PE, experimental conditions and reinforcement types and amounts [7].

CONCLUSION

New active antimicrobial polymer composites are greatly promising in the development of packaging materials. In the present work, the FAP/ HDPE composite was prepared by simple extrusion process. The presence of FAP nanoparticles in the HDPE polymer matrix were confirmed by XRD and TEM analysis. The synthesized fluorapatite/polyethylene composite is promising as active food packaging material.

Acknowledgement

This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project III 43009).

REFERENCES

[1] C. Silvestre, D. Duraccio, S. Cimmino, Progress in Polymer Science, 2011, **36**, 1766–1782.

[2] P. Appendinia, J. H. Hotchkiss Innovative Food Science and Emerging Technologies 2002, **3**, 113-126.

[3] V. Stanić, S. Dimitrijević, D. G. Antonović, B. M. Jokić, S. P. Zec, S. T. Tanasković, S. Raičević, Applied Surface Science, 2014, **290**, 346-352.

[4] S. Jantová, M. Theiszová, S. Letasiová, L. Birosová, T.M. Palou, Mutation Research, 2008, **652**, 139–144.
[5] J. Wei, J. Wang, W. Shan, X. Liu, J. Ma, C. Liu, J. Fang, S. Wei, Journal of Materials Science: Materials in Medicine, 2011, **22**, 1607–1614.
[6] F. Chouit, O. Guellati, S. Boukhezar, A. Harat, M. Guerioune, N. Badi, Nanoscale Research Letters 2014, **9**, 288.
[7] P. N. Khanam, M. A. A. AlMaadeed, Advanced Manufacturing: Polymer & Composites Science, 2015, **1**, 63-79.