Synthesis and Characterization of Hydroxyapatite Nano materials using chemical method

The 5th International Scientific Conference for Nanotechnology and Advanced Materials and Their Applications (ICNAMA 2015) 3-4 Nov.2015

Suhair Shakir Majeed
College of Science, Al-Mustansyriah University, Baghdad
Sahar Abdul Aziz Mohammed
College of Science, Al-Mustansyriah University, Baghdad
Huda Talal Sulaiman
College of Science, Al-Mustansyriah University, Baghdad
Luma Malak
College of Science, Al-Mustansyriah University, Baghdad

Abstract

Synthesis natural hydroxyapatite in different nanostructure shapes and sizes such that the toxicity is reduced to the minimum for an individual application. However, the synthesis and functionalization processes are accomplished using chemical method. The morphology of the HAP nanoparticles changes from rod to spherical. Rod shaped particle are found with length between 10-20 nm while the spherical particles are found with radius less than 10 nm. But for the pure HAP only rod morphology observed with the size ranging from 30-60 nm.

Keywords: Hydroxyapatite, FESEM, Chemical method.

تحضير ودراسة خصائص الهيدروكسيل-ابتايت النانوي باستخدام طريقة كيميائية

الخلاصة:

في هذا البحث تم تحضير مادة الهايدروكسيل-ابتايت الطبيعي باشكال واحجام نانوية مختلفة وذات سمية قليلة لغرض استخدام المادة في تطبيقات وذلك باستخدام طريقة كيميائية. من خلال دراسة السطح للمادة المحضرة وجد انها تكون باشكال كروية وقضيب ذات طول يتراوح بين 10-20 nm واقطار اقل من 10 nm .

INTRODUCTION

Hydroxyapatite (HA), is one of the mineral components of human bones and belongs to the apatite family represented by $M_{10}(XO_4)_6Z_2$, where M is a divalent cation coordinated with XO_4^{3-} and Z anions [1]. The composition of HA $(Ca_{10}(PO_4)_6(OH)_2)$and its synthetic formshave been studied to develop materials for diverse biological or biomedical applications such as: Scaffolds for tissue engineering, delivery systems of anti-cancer drugs or particles with the ability to recognize specific cells [2]. A key step in the material design to implement these applications, is the functionalization of HA particles with one or more organic components depending on the desired final features. Pure hydroxyapatite has a chemical composition, biological and crystallographic closely similar to humanbone and teeth. Scientific studies reported its

http://doi.org/10.30684/etj.2015.116634
2412-0758/University of Technology-Iraq, Baghdad, Iraq

medical uses as afiller in amputated bones or as a coating to promote bone ingrowth into prosthetic implants. It has been suggested that this material may promote ossification and many modern implants are coated with hydroxyl-apatite. Recently, hydroxyl-apatite has been used as a semi-permanent filler in non-surgical options for treating wrinkles and textural changes in skin rejuvenation. Moreover, as the main component of dental enamel, it is reported to protect it from acid erosion and to exhibit enamel restoring effects, as well as an anti-plaque and anti-stain activity [3, 4]. HAp is derived from natural materials such as coral and fish bone, fish scale as well as from other animal bones.

Method section:

Fish scales were collected from fresh water fish and washed thoroughly in running tap water. The collected scales were initially de-proteinized through external washing with 1 (N) (HCl and H_2SO_4) (35%) solution (2:1, v/w, water HCl /fish scale) for 24 hours at room temperature (25° ±2°C). Next, the de-proteinized fish scales were washed thoroughly several times with distilled water. Remaining proteins of fish scales were treated with 1(N) NaOH solution. The filtered fish scales were washed thoroughly with distilled water and dried at 60°C in hot air oven for several hours. Treated fish scales were calcined at different temperatures to synthesize HAp ceramics.

Results and Discussions:

The morphology of the HAP spherical nanoparticles. Spherical particles are found with radius less than 10 nm. But for the pure HAP only rod morphology observed with the size ranging from 30-60 nm as shown in figure (1) (A, B) and (2).

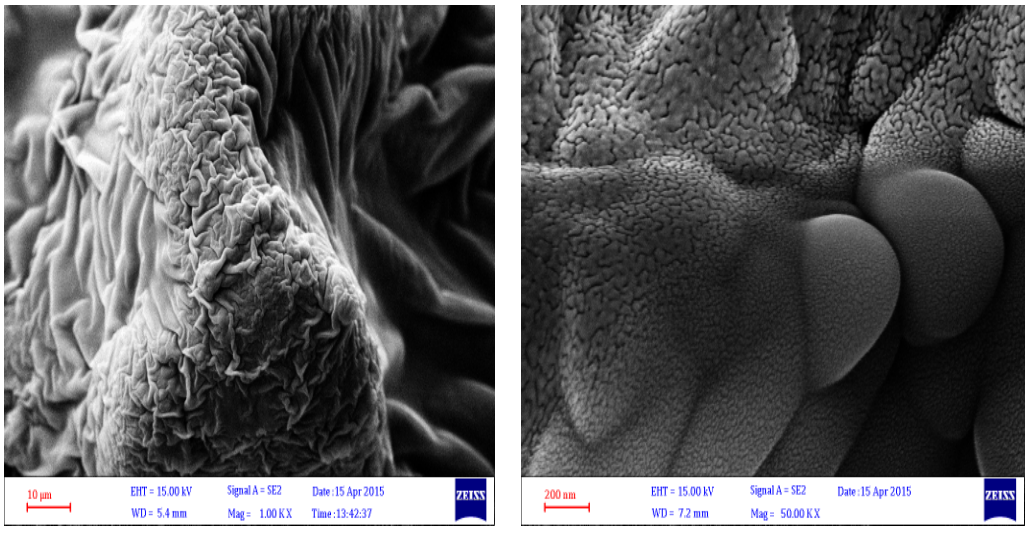

Figure (1): FESEM of hydroxyapatite prepared using chemical method.

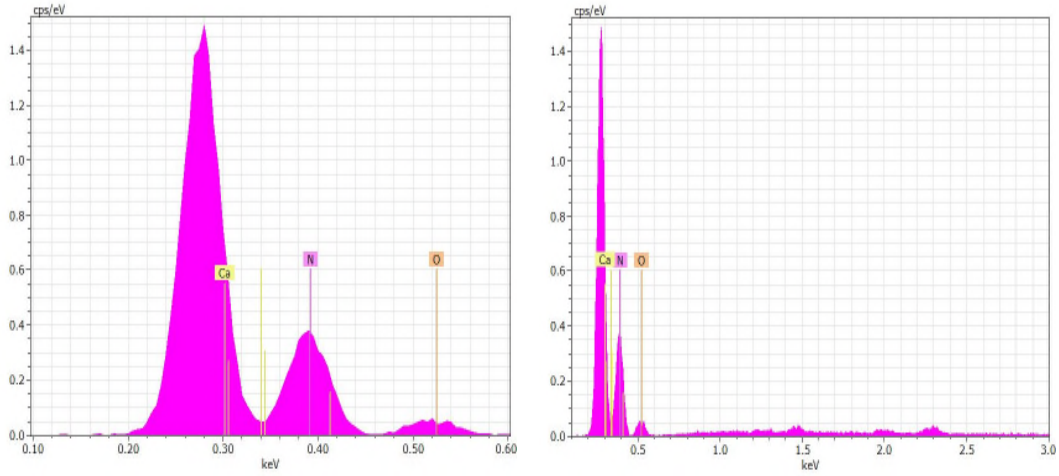

Figure (2): EDS of hydroxyapatite prepared using chemical method.

XRD patterns of synthesized HAp particles from fish scales are shown in figure (3). The crystalline phase analysis of the HAp powder from bio sources were carried out by x-ray. Each pattern showed HAp as the only phase.

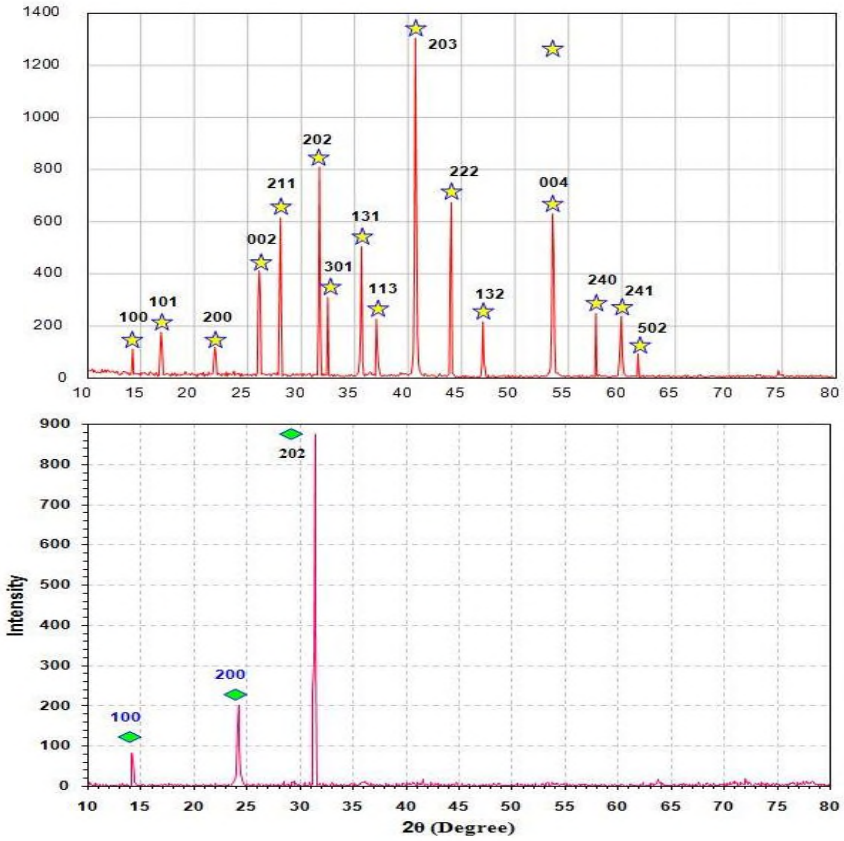

Figure (3): XRD of hydroxyapatite prepared using chemical method.

Conclusions:

Synthesis natural hydroxyap atite using chemical method. The surface morphology of the HAP spherical nanoparticles particles are found with radius less than 10 nm. The crystalline phase analysis of the HAp powder from bio sources were carried out by x-ray. Each pattern showed HAp as the only phase.

References:

[1] Mobasherpour, I., Heshajin, M. S., Kazemzadeh, A., M. Zakeri, M., 2007, ‘‘Synthesis of Nanocrystalline Hydroxyapatite by using Precipitation Method,’’ J. Alloys Compd., Vol. 430, pp. 330-333.

[2] Parthiban, S.P., Elayaraja, K., Girija, E. K., Yokogawa, Y., Kesavamoorthy, R., Palanichamy, M., Asokan, K., and Narayana Kalkura, S., 2009, “Preparation of thermally stable nanocrystalline hydroxyapatite by hydrothermal method.” J. Mater. Sc: Mater. Med., Vol. 20, pp. 77-83.

[3] Kim, W., Zhang, Q., and F. Saito., 2000, “Mechanochemical synthesis of hydroxyapatite from $Ca(OH)_2$-P_2O_5 and CaO- $Ca(OH)_2$-P_2O_5 mixtures.” J. Mater. Sci., Vol. 35, pp. 5401-5405.

[4] Balamurugan, A., Kannan, S., and Rajeswari S., 2002, “Bioactive sol-gel hydroxyapatite surface for biomedical applications-in vitro study.” Trends. Biomater. Artif. Organs, Vol. 16, pp. 18-20.