Study on Hydroxyapatite Nano Reinforced by Ultrasonic Preparation

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ABSTRACT

This paper prepared by ultrasonic reinforced hydroxylapatite nano-materials, nano-HAP belongs resulting hexagonal crystal grain size are 10-20nm level, belong to smaller nanometer range; the product is difficult in the conventional synthetic methods obtained hollow spherical structure, therefore, to strengthen the preparation of ultrasonic method has wide application to promote significance.

INTRODUCTION

With the continuous development of science and technology and human society, people's living standards continue to improve. However, people have to face the increasing problems caused by disease of bone defects, trauma and other external causes. For small volumes of bone defects, bone can achieve self-healing, and will not leave scar. However, for large volume bone defect or a large section of bone tissue can not heal, if not repaired, will be unable to restore its function. For this relatively large area of severe bone defects, bone graft required to restore function[1]. For the repair of bone defects, there are a variety of methods, including traditional autologous bone and bone allograft. Although since the allograft bone and clinical effect is considered to be a good treatment, but there is a finite source and bone infections and other shortcomings. The synthetic bone graft material to a certain extent, can reach autologous and allogeneic bone repair effect, and also to avoid infections and bone finite sources such problems, therefore, clinically for synthetic bone graft material has a great It needs[2].
With the rapid development of modern civilization, people's work life pressures, health issues are becoming a big concern. Due to market forces, biomedical materials and products in research and development and use of more and more by the government and research institutions attention, it is of great significance for economic and social development. The last three decades, though the research and development of biomedical materials made remarkable achievements, making millions of patients access to rehabilitation, greatly improving the quality of human life[3-6]. With the trauma caused by the development of science and technology and an aging population, as well as industry, transport, sports and other increased demand and dependence on biomedical materials and products is growing. However, due to the limitations of cost, clinical practice, research and application of materials, biomedical materials and products have not been widely developed applications.

Nanotechnology research is the movement of the material by the size between 0.1-100 nm consisting of system and interaction as well as the practical application of technical problems in science and technology[7-9]. When the particle size into the nanometer range, because of its own quantum size effect, small size effect, surface effect and macroscopic quantum tunneling effect, but exhibit many unique properties, large surface area, improve the performance of chemical reactions, melting point lower, mechanics performance changes, changes in the magnetic and optical properties change. Therefore, nanomaterials have broad applications in catalysis, optical, optical absorption, medicine, magnetic media and new materials, but will also promote the development of basic research.

Sonochemical is an emerging interdisciplinary, early in 1927 on the chemical action of ultrasound received attention, but until the 1980s Sonochemical really began to perk up, on the one hand because of the development of science and technology for a variety of efficient and economical production of durable power ultrasonic source provides excellent acoustic performance materials and electronic devices; on the other hand is out to explore the need for new materials, new technologies and new processes. Sonochemical this subject has just appeared, it was highly valued scientific community. European and American scientists have held almost every year the Symposium on sound chemistry, and founded the international "Sonochemical" magazine in 1994. Ultrasound as a new form of energy acting on the chemical reaction, it can use ultrasonic energy to accelerate and control chemical reactions substances can improve the reaction yield and lead to a new chemical reaction, so many in the past can not be or difficult to carry out the reaction to smooth, it has been widely used in synthetic chemistry, materials science, and wastewater treatment.

Therefore, this paper uses ultrasound to strengthen hydroxyapatite nano-materials, to explore the preparation process, and material properties were characterized in order to provide reference for industrial scale applications.
MATERIALS, REAGENTS AND METHODS

Instrument

752 UV-Vis spectrophotometer, AY120 electronic analytical balance, AY120 electronic analytical balance, KH-400KDB CNC high-power ultrasonic cleaner, digital temperature drying oven, D8-ADVANCE X-ray powder diffraction, TENSOR-37 Fourier transform infrared spectrometer.

Reagents

Ca(NO$_3$)$_2$•4H$_2$O, (NH$_4$)$_2$HPO$_4$, ammonia, acetaminophen, phenol and ethanol.

The Pre-reaction HAP Sample Preparation

Control experiments Ca(NO$_3$)$_2$•4H$_2$O and the molar ratio of (NH$_4$)$_2$HPO$_4$ is 1.67. Specific experimental procedure is as follows: 5: 3 molar ratio of calcium nitrate solution were prepared and diammonium phosphate solution: Weigh 11.808g Ca(NO$_3$)$_2$•4H$_2$O, and 3.962g (NH$_4$)$_2$HPO$_4$, were dissolved in deionized water, formulated as 0.050mol/L of Ca(NO$_3$)$_2$ solution and 0.030mol/L of (NH$_4$)$_2$HPO$_4$ solution.

Preparation Of Nano-HAP Under Ultrasound

Amount of the same volume of the above with a good solution 20mL of two, both with aqueous ammonia to adjust the pH of the solution was 10 to 10.5, and the auxiliary ultrasonic vigorous mechanical stirring (ultrasonic power: $W = 400W$, mechanical agitation speed: $n = 200$ switch/min) of the latter (0.030mol/L of (NH$_4$)$_2$HPO$_4$ solution) was slowly added dropwise (<10mL/min) using a separatory funnel and constantly stirred calcium nitrate solution, and treated with aqueous ammonia to control the pH value of 10 to 10.5, the reaction temperature is room temperature 25°C. Until the addition was complete, continue to ultrasound and to assist with vigorous mechanical stirring 2h, and then the reaction product was allowed to stand for aging for about 12h, the supernatant decanted lower sediment centrifugation, thoroughly washed with deionized water centrifugal separator 3 to 5 times, each time 15min, to remove the ammonium ion, until neutral, after which the product was oven dried transverse temperature 80°C 12h to give HAP powder sample denoted as S2.
RESULTS AND DISCUSSION

FTIR Results Of Sample S2 (See Figure 1)

Can be seen from Figure 1, in 473,569,608 is P-O bending vibration absorption peaks, which peaks at 569,608, features clear, 960,1030 is P-O asymmetric stretching vibration absorption peak characteristics obviously, there is a preliminary determination and more content. 874,1418,1458 vibration absorption peak, which appeared 1418 and 1458 peaks, into the apatite structure is an important symbol, can explain the structure of a solid solution powder HAP part of the structure, less content, presence is Since the powder absorbs the air of reason in the synthesis, the aging process. 1645 is the adsorbed water absorption peak, 3445 is the symmetric O-H stretching vibration peak, and therefore the infrared analysis confirmed the sample S2 in phosphate and hydroxyl is present.
XRD Results Of Sample S2 (See Figure 2)

According to X-Ray Diffraction Standards JCPDS standard card PDF # 09-0432 Poor Richard hydroxyapatite, it can be seen from Figure 2, product of 25.82°, 32.03°, 39.75°, 46.65°, 49.40°, 53.26°, 64.15° hydroxyapatite also appeared at several characteristic peaks, corresponding to the HAP crystals (002), (211) (130) (222) (213) (004), (323) crystal face diffraction characteristics, indicating that the product is prepared hydroxyapatite crystals, belonging to hexagonal nano-HAP. Octavia peak shape, FWHM small, indicating good crystal diffraction peak width illustrate got smaller particle diameter.

In addition to the characteristic peaks of hydroxyapatite, it can also be seen in about 78 ° to trace impurity peaks, combined with the IR spectrum shows the trace impurity peak may belong carbonate; other (002), (211), (213) high diffraction intensity peaks of planes, thus indicating a higher purity of hydroxyapatite powder preparation, more content.
CONCLUSIONS

In the present study, prepared under ultrasound hydroxyapatite nano-materials, the results are as follows: Ca (NO$_3$)$_2$ • 4H$_2$O and (NH$_4$)$_2$HPO$_4$ as raw material, can be prepared using ultrasonic nano HAP, resulting nano HAP belongs to hexagonal crystal grain size are 10-20nm level, belong to smaller nanometer range; the product is a hollow spherical structure in the conventional synthetic methods is difficult to obtain, and can be used as drug delivery materials, has broad application prospects. Therefore, this production method has the craft to promote significance.

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