

Bone Regeneration Using Nanotechnology – Calcium Silicate Nano-Composites

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ABSTRACT

Calcium phosphate ceramics are rapidly degraded faster than the rate of tissue formation, which makes no Scaffolding enough strength and makes it unsuitable for applications that are bearing the load. Therefore Bio-Ceramic a new generation of ceramics, with calcium silicate (Ca-Si) attention attracted to. One way to improve the biochemical properties of these metal ions into their structure is Bio-Ceramic Add. Nowadays, along with approaching the normal structure of bones and making use of the properties of nanotechnology researchers to build nano-composite scaffolds were driven.

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1. Introduction

Currently, tissue engineering techniques for the repair and regeneration of tissues and organs such as bone, skin, cartilage, liver, bladder, ligaments, nerves, heart valves, etc. are used, so that in all the areas mentioned the result has been a remarkable success and they will be added each day on the slopes. Tissue engineering of multiple fields of science and engineering principles of biological science that aims to develop biological alternatives aim to restore, repair and maintain, or improve tissue function to be. Compared with classical biomaterial, tissue engineering is based on understanding the formation and remodeling [1]. Isolated cells injected into the body alone can not shape the context. These cells need to have a good environment in which the material is similar to an underlying support for cell cultures in vitro procedure [2]. Thus, the extracellular matrix or porous material as a scaffold for cell growth has been prepared and placed on growth factor [3]. After growth of cells in vitro to in vivo environment of the porous scaffold is transmitted. Vessels are gradually penetrated into the scaffold so that the cells are fed. By definition, for a tissue engineering approach to the design of a scaffold with proper physical structure to allow cell adhesion, migration, proliferation, and cell differentiation and the growth and replacement of new tissue [4].

2. Biomaterials

Biomaterials, synthetic material that is used to replace or substitute a part of the human body in close contact with

living tissue or organism used. In vitro inert biomaterials in terms of pharmacology in neutral and implanted in living systems or associated with them has been designed [5]. Bio Ceramics are a class of natural or synthetic materials to repair, reinforce or replace the defective or disabled part of the body's tissues and organs used for limited or unlimited. Bio-ceramics may be in the form of single crystals, poly-crystals (hydroxyapatite), containing an amorphous phase (Bio-glass) or composite to be built and physically able to form a granular, porous parts, dense bodies and covers are used. For repair of large bone defects using ceramic scaffolds are not sufficient for full reconstruction. Hence, to strengthen the bone behavior of other compounds, such as bone-building cells or large molecules that induce bone and silicate minerals such as zinc, etc. can be found in natural bone, is used. This scaffold is an important preoccupation of the inherent brittleness of calcium phosphate [6].

3. Methods of making ceramic scaffolds

So far, several methods to produce porous scaffolds for bone tissue engineering for various applications have been studied Each has its own advantages and limitations of some of the most important of these processes is given below. In this study, mechanical alloying method has been used to create nano-composites.

- particle washing method
- Electro-spinning
- The phase separation
- Rapid Prototyping

- Picking a layered approach
- Mechanical alloying method

4. Results

The results of powder X-ray diffraction is shown in Figure 1. Pattern observed in this figure shows the corresponding Hardystonit reference card (JCPDS no. 35-745) and crystal plates (211), (201), (111), (310) and (312) is. Hardystonit powder pattern of tetragonal structure with $a=7.8287$ and $c=5.0140$ angstrom fixed network specifies [7]. In addition, sharp peaks indicating the crystalline structure Hardystonit after heat treatment.

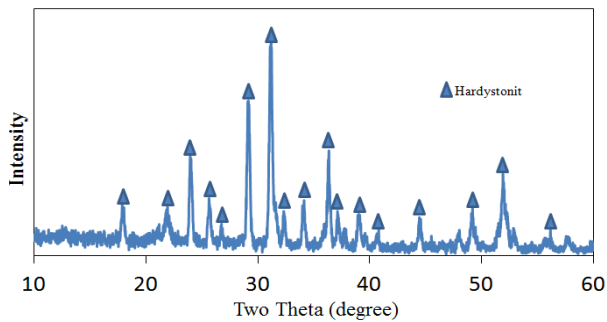


Figure 1. XRD pattern

TEM analysis Hardystonit resulting powder is given in Figure 2. As indicated in this figure is due to the complex microstructure of powder or flakes Hardystonit have to be contiguous. Moreover, this image shows Hardystonit powder made from heat structure and nano-crystalline grain size in the range of 100-50 nm and spherical shape.

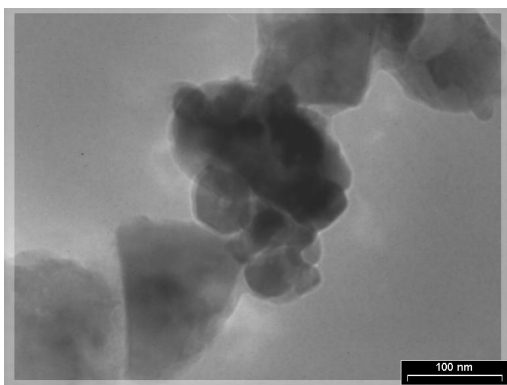


Figure 2. TEM image analysis

SEM analysis of the resulting nano-composite scaffold is shown 4-3 . As seen in this figure is a composite of interconnected porous structure. In the picture we can see that with the increase of porosity, pore Hardystonit gets older . More than 5% to 20% Hardystonit go Hardystonit ago. Ceramic phase pore sizes less than nm 100 and distributed almost uniformly evident. This scaffold percent of the original variable in the process of making calcium silicate powder is added to the two-component composite .. Usually washing scaffold is also not fully exit the other hand, a high concentration of the solution remains soluble

after drying is used to make gelatin Brittle is important so choosing the right concentration.

5. Discussion

The selection procedure was chosen to build the scaffolding so that the final porosity is desirable to provide the ability to create and control . Morphology and Porosity Porosity is generally an important factor in determining tissue engineering is discussed . Kashtnyhay Kashtnyhay has no porosity and low porosity and connectivity to support tissue growth into the implants are not suitable for tissue engineering applications . Studies suggest that pore size implants to ensure the growth of blood vessels must be at least equal $\mu\text{m } 50$ [8] . However, if they exceed the size of the border $\mu\text{m } 200$ mechanical properties of the material can be problematic . Research has shown that the minimum pore size for bone growth and mineralization against non-mineral Osteoma growing $\mu\text{m } 100$ $\mu\text{m } 40$ to 100 range for the growth of fibrous tissue between $15 \mu\text{m } 5$. The trellis structure is found in the larger pores , but their number is small. Cavity with an elliptical morphology are interrelated in many parts of the organization to their show . These features influence the growth of bone tissue into the scaffold is very important . Surface structure of elliptical cavities is evident in all samples , but what caused the differentiation of these samples is the amount of surface. As you can see the number increasing calcium silicate surface is reduced and appears to increase the amount of calcium silicate entire sample is dropped . Although the relationship between pore is visible in most cases , but we can say that a high percentage of calcium silicate in addition to reducing the number of pores per unit area will be reduced interconnect them so that the sample contains 20% virtually vacuoles alone Hardystonit contact others are viewing . In addition, calcium silicate samples with fewer elliptical morphology, porosity greater than samples with higher calcium silicate is maintained. In some places, the porosity of the honeycomb structure is evident . At higher magnification the distribution of particles of calcium silicate composite samples is visible in gelatinous . With increasing calcium silicate particle distribution is more uniform , and it is quite clear from the comparison images . Process temperature (60 degree) is virtually above the gelation temperature of 40°C 35 is thus gelatin , gelatin sol irregularities in the temperature at which long chains to form the dispersed are irregular and the coil . Under these conditions, chain fall apart because the lowest intermolecular forces and interactions between them. During the cooling of the polymer , and the polymer solution to achieve the gelation temperature of the frozen gel is a process in which the physical crosslinking of gelatin chains and network are to create the solvent water the trap his this phenomenon was originally cast as collagen, which creates a wrinkled mass of physical nodes and thereby causing gelation polymer molecules are locked inside . Here can be reduced by increasing the porosity of the composite scaffolds received calcium silicate . Since the mechanism of porosity created by the dissolution of the gelatin is based primarily on the calcium silicate added is less tendency to foam , resulting in increased porosity of the material, the more will be resulted.

5. Conclusions

MAP The map is shown in Figure 4-8 Results of analysis of how Tasyzrat second phase polymer composites with improved bioactivity Nnshan on that . Bioactive particles in the inner and outer composite is increased bioactivity . By placing the samples in a solution of calcium and phosphate ions in the SBF solution and that other elements on the surface sediment samples from the MAP images visible. PH changes are the result of nano- composite scaffolds after immersion in intervals of 3, 7, 14 and 21 days in SBF solution can be seen in Figure 4 . Due to pH changes can be observed that the pH value of the scaffold containing over 21 Hardystonit efficiency in the range of physiological pH was 7.2 to 7.4 that indicates the chemical stability of the composite scaffolds . This indicates that the chemical stability, bio- ceramic composites of the gelatin did not affect Hardystonit.

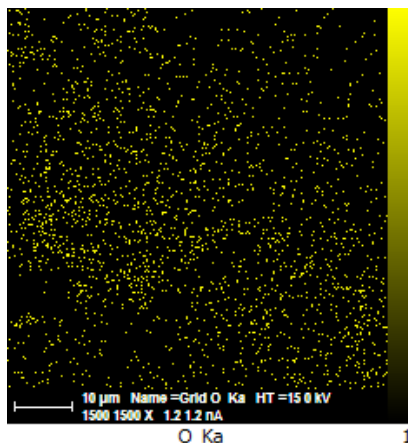


Figure 3. MAP analysis of the samples after 7 days 5% efficiency in the SBF solution

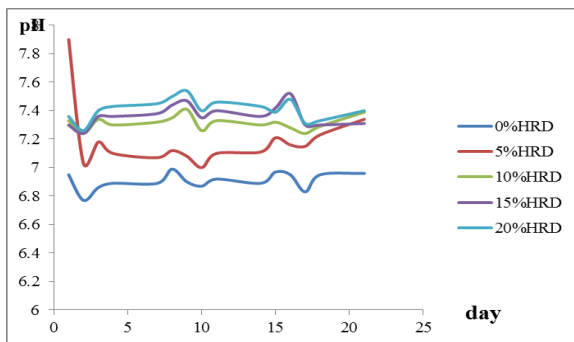


Figure 4. The variation of pH immersing the composite samples at certain intervals

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