SYNTHESIS AND CHARACTERIZATION OF STRONTIA NANOPARTICLES

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ABSTRACT

Biomaterial is defined as any substance which is fabricated to work with the biological system either for therapeutic or diagnostic application in medical field. Strontia nanopowder is synthesized by wet process. Strontia is obtained by the reaction of Strontium chloride hexahydrate and Potassium hydroxide pellets followed by dehydration and calcination. The obtained nanopowder is characterized by XRD and tested for anti-microbial activity. XRD helps to show the unit cell dimensions and is used for phase identification of crystalline materials. The prepared nanopowder size is determined using Scherrer equation. The Strontia synthesized is biocompatible, has anti-inflammatory, anti-microbial and osseointegration properties which can be used for making implants.

Keywords: Anti-microbial activity, Fourier Transform Infrared Spectroscopy, Strontia nanopowder, X-ray diffraction.

1. INTRODUCTION

The study of biomaterials is called biomaterial science or biomaterial engineering. It includes elements of medicine, biology, chemistry, tissue engineering and material science. It is available both naturally and can also be prepared by chemical synthesis. It must be biocompatible in order to replace the natural function of the body. It is widely employed in dental applications, medical applications and drug delivery. Medical device which is engineered to support the damaged biological structure or to replace it is called an implant. Strontium has physical and chemical properties similar to that of calcium. It behaves like...
calcium in human and helps in bone growth and osseointegration. It occurs naturally and is the 15th most abundant element in the Earth’s crust. The human body absorbs strontium as if it were its lighter kind of calcium. Since the elements are chemically very similar to Calcium, stable strontium isotopes do not pose a significant health threat. It has good corrosion resistance property than that of stainless steel and titanium. Strontium produce strontium oxide when exposed to air which replicates the properties of strontium. Strontium oxide or Strontia is basic in nature and is in the form of white powder. It has cubic crystalline structure with a high melting point of 2,531°C. Strontia is soluble in potassium hydroxide, slightly soluble in alcohol but insoluble in acetone and ether.

2. MATERIALS AND METHODS

2.1 Materials

Strontium chloride hexahydrate, Potassium hydroxide pellets, Toluene and ethanol were purchased from Fischer Scientific. All chemicals purchased were of analytical grade.

2.2 Synthesis of Strontia Nanopowder

25 g, 446.43 mmol of Potassium hydroxide pellets were dissolved in a mixture of water and Toluene in the ratio 1:15 followed by addition of 59.52 g, 223.24 mmol of Strontium chloride hexahydrate dissolved in water and is stirred for 2 hrs. The obtained solution is heated at 100°C in water bath for 8 hrs. The resultant obtained is kept overnight and filtered. The obtained filtrate is Strontium hydroxide which is washed with a mixture of Toluene and ethanol. This Strontium hydroxide is kept in hot air oven at 100°C for 24 hrs. The obtained powder is calcined at 700°C in muffle furnace. The white powder which is obtained is Strontia nanopowder.
The governing equation is given by,

$$\text{SrCl}_2 \cdot 6\text{H}_2\text{O} + 2.4\text{KOH} \rightarrow \text{Sr(OH)}_2 + 2\text{KCl} + 6\text{H}_2\text{O}$$

$$\text{Sr(OH)}_2 \rightarrow \text{SrO} + \text{H}_2\text{O}$$

3. RESULTS AND DISCUSSION

3.1 X-Ray Diffraction (XRD)
The strong and sharp peaks that are present show the crystalline structure and purity of Strontia nanoparticles. The peaks were studied using X’pert Highscore software. The analysis confirmed the Orthorhombic phase of Strontia nanoparticles and the size of nanoparticles were calculated to be 32.6nm.

3.2 Fourier Transform Infrared Spectroscopy (FTIR)

The band observed at 630 cm$^{-1}$ and the peak at 853.95 cm$^{-1}$ shows the Sr-O bond. The peak observed at 1444.08 cm$^{-1}$ shows the presence of OH after the absorption of moisture from atmosphere during the synthesis.

Fig 3: FTIR

3.3 Anti-microbial activity

It is done inorder to identify the bacterial susceptibility to the synthesized sample. The anti- microbial testing was done with Bacillus subtilis. The zone formed around the synthesized sample shows it resisting activity. The diameter of the zone formed is found to be 2 cm.
4. CONCLUSION

Thus, this work helps to serve as a useful biomaterial in the field of medicine which can be used to develop an implant as the synthesized Strontia nanopowder shows good biocompatibility and anti-bacterial activity.

REFERENCES

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