

**SYNTHESIS AND CHARACTERIZATION OF
NANO - HYDROXYAPATITE CERAMICS FOR
BIOMEDICAL APPLICATIONS**

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Dissertation submitted in partial fulfillment of the requirements for the Degree of
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DECLARATION

I declare that this is my own work, and this dissertation does not incorporate without acknowledgement any material previously submitted for a degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in text.

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The above candidate has carried out research for the partial fulfillment of the requirements for the Degree of Master of Science in Material Science under my supervision.

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Abstract

This research focuses on the synthesis and characterization of nanohydroxyapatite (nHA), a promising biomaterial with significant potential for various biomedical applications. Sintering process was carried out on the synthesized nanohydroxyapatite to enhance the properties and performance, making it more suitable for a wide range of applications in the fields of medicine, dentistry, and materials science.

The synthesis of nHA was carried out using a modified wet chemical precipitation method, utilizing analytical grade Calcium hydroxide (98%) and Orthophosphoric acid (88%) as the precursor materials. The reaction parameters, including reaction time, temperature, and pH, were carefully optimized to achieve the desired nanoscale particle size and morphology.

X-ray diffraction (XRD), characterization technique was used to confirm the presence of nHA. Once the presence of nHA was confirmed. The fine powder was compressed to form discs, using steel mold. The prepared discs were then subjected to different sintering temperatures, to investigate the structural, morphological, and chemical properties of the sintered nHA. The sintered samples were then characterized, using characterization techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier-transform infrared spectroscopy (FTIR).

FTIR analysis demonstrated characteristic vibrational bands of hydroxyapatite, including the phosphate (PO_4^{3-}) stretching vibrations at wavenumbers of 1040 cm^{-1} and 566 cm^{-1} , and Hydroxyl (OH^-) stretching vibrations at a wavenumber of 3570 cm^{-1} . SEM images revealed the formation of well-defined nanosized particles with an average diameter of approximately 56 nm. XRD analysis confirmed the presence of hydroxyapatite crystal structure, exhibiting sharp diffraction peaks corresponding to (211), (300), (002), and (310) planes.

Furthermore, the total mass loss, water absorption, and porosity of the synthesized sintered nHA were determined. The results indicated the sintering behavior of synthetic nanohydroxyapatite varies depending on the sintering temperature. Notable differences were observed in terms of mass loss, water absorption and porosity.

In conclusion, the best sintering temperature that can be used in biomedical applications is 1200°C . This research contributes to the advancement of nanohydroxyapatite materials and lays the groundwork for further exploration and application in the field of biomaterials science.

Key words: nanohydroxyapatite, wet chemical precipitation, sintering, Calcium hydroxide, Orthophosphoric acid.

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LIST OF ABBREVIATIONS

HA	Hydroxyapatite
nHA	Nano Hydroxyapatite
FTIR	Fourier transform infrared
SEM	Scanning Electron Microscope
XRD	X-Ray diffraction