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**Abstract**

It is well documented that biological hydroxyapatite (HA) differs from pure and synthetically produced HA, and contains of a mixture of calcium phosphate (CaP) phases in addition to a range of impurity ions, such as strontium ( $\text{Sr}^{2+}$ ), zinc ( $\text{Zn}^{2+}$ ), magnesium ( $\text{Mg}^{2+}$ ), fluoride ( $\text{F}^-$ ) and carbonate ( $\text{CO}_3^{2-}$ ), but to name a few. Further to this, biological apatite is generally in the form of rod (or needle-like) crystals in the nanometre (nm) size range, typically 60 nm in length by 5-20 nm wide. In this study, a range of nano-hydroxyapatite (nHA), substituted nHA materials and co-substituted nHA (based on  $\text{Sr}^{2+}$  and  $\text{Zn}^{2+}$ ) were manufactured using an aqueous precipitation method.  $\text{Sr}^{2+}$  and  $\text{Zn}^{2+}$  were chosen due to the significant performance enhancements that these substitutions can deliver. The materials were then characterised using Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), X-Ray Photoelectron Spectroscopy (XPS) and Transmission

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