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Research paper

Mechanical parameters of strontium doped hydroxyapatite sintered using microwave and conventional methods

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ABSTRACT

The effects of ion substitution in hydroxyapatite (HA) on crystal structure and lattice stability is investigated in the green state and post sintering. The effects of ion incorporation on the biaxial flexural strength and hardness are also investigated. Sintering is carried out at 1200 °C using comparative conventional and microwave regimes. Post sintering, the effects of ion incorporation manifest as an increase in the lattice *d*-spacings and a reduction of the crystallite size. Some HA decomposition occurs with β-TCP stabilisation in conventional sintering (CS), but this phase is destabilised during microwave sintering (MS), generating α-TCP. Conventional sintering (CS) allows higher densification in the undoped samples. Overall, for the Sr-doped compositions, the MS samples retain higher amounts of HA and experience higher density levels compared to the CS samples.

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1. Introduction

The structure of the strontium ion (Sr^{2+}) is similar to that of the calcium (Ca^{2+}) ion in view of comparable atomic radii (Li et al., 2007). Sr can substitute for Ca in many of the physical processes of the body, including muscular contraction and blood clotting (Pors Neilsen, 2004). Incorporating Sr into the hydroxyapatite (HA) lattice structure has become of significant interest due to the fact that Sr has a biological role in bone, where it decreases the activity of osteoclasts and increases the activity of osteoblasts (Matsuyuki and Murata, 2009; Canalis et al., 1996). The positive effects of Sr on bone are evident from the commercially available osteoporosis treatment that is based on Sr, Protelos® (Servier Laboratories, Dun Laoghaire, Dublin), which is a compound containing the organic acid, ranelic acid, and two atoms of stable Sr (Meunier et al., 2002).

HA ($Ca_{10}(PO_4)_6(OH)_2$) is used as a replacement for bone due to its biocompatibility (Kalita et al., 2006; Prabakaran et al., 2005) and its osteoconductive properties (Erbe et al., 2001; Itoh et al., 2000). One of the main factors leading to the success of implants is the extent of osteointegration between the implant and the surrounding tissue. This can

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