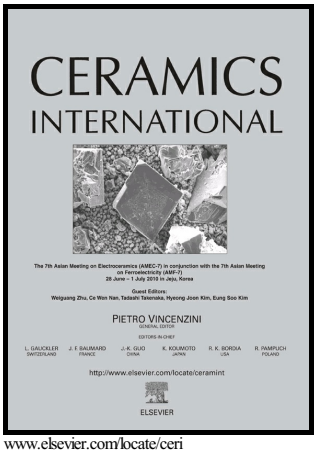

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Sr-doped forsterite nanopowder: Synthesis and biological properties

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Abstract

Nanoscale forsterite (Mg_2SiO_4) has recently been proposed for bone tissue engineering application. Due to the special role of strontium (Sr) in bone remodeling, the stimulation of bone formation and reduction in bone resorption, the modification of forsterite by doping with Sr is expected to increase bioactivity and biocompatibility. The aim of this study was to incorporate Sr (0, 0.05, 0.1, 0.2 and 0.4 at.%) into forsterite using sol-gel method and to investigate the effect of Sr content on the phase composition, *in vitro* apatite-formation ability as well as osteoblast-like MG63 cell viability. Results demonstrated that while forsterite was the main phase of all Sr-doped forsterite nanopowders, $Sr_2MgSi_2O_7$, MgO, $MgSiO_3$ were present as the minor phases depending on the Sr content. Moreover, the presence of Sr atom influenced the crystallite and particle size as well as lattice parameters of the forsterite powder, while did not significantly change the morphology of particles. Noticeably, the incorporation of Sr up to 0.2 at.% enhanced the average crystallite size (from 25.3 nm to 45.9 nm) and particle size (31.0 ± 3.9 nm to 62.9 ± 11.8 nm) of pure forsterite powder. Additionally, according to the Rietveld refinement, the incorporation of Sr up to 0.2 at.% increased the lattice parameters of forsterite more than 0.1%, depending on the Sr content. *In vitro* bioactivity assessment in simulated body fluid (SBF) revealed while all Sr-forsterite samples possessed greater bioactivity than pure forsterite nanopowder, the incorporation of 0.1 at.% Sr revealed improved bioactivity compared to other Sr-forsterite samples. However, according to MTT assay, while all forsterite-based ceramics significantly improved the cell proliferation compared to tissue culture plate (TCP) and forsterite nanopowder, Sr-forsterite nanopowders consisting of 0.05-0.1 at.% Sr revealed a considerably promoted cell proliferation. In conclusion, Sr-forsterite nanopowder could be a promising candidate for bone tissue engineering and reconstruction of bone defects such as osteoporosis.