Fabrication and Sintering Behavior of Zinc-Doped Biphasic Calcium Phosphate Bioceramics

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Abstract

Dense bioceramics with improved mechanical properties have been prepared using sol-gel derived zinc doped biphasic calcium phosphate (BCP) powders. Zinc concentration was varied in the range of 0,1, 2, 4, 5, 10, and 15mol%. The compaction of the powders followed by sintering provided the dense ceramics. The effects of zinc concentration doped and sintering temperature on phase stability and mechanical characteristics were examined. The presence of Zn changed the phase of dense BCP, leading to improved mechanical properties. Zn free BCP attained the highest density of only 92.6% after 1400 degrees C sintering, equally achieved by 4mol% Zn-doped BCP at a lower temperature of 1200 degrees C. It is presumed that the steady increase in the compact density up to 4mol% zinc incorporation was contributed by progressive consolidation in the BCP structure, but the density dropped again from 5mol% until 15mol% due to low density beta-tricalcium phosphate phase formation. This study showed that Zn doping was effective in producing high strength dense BCP with 3.40GPa hardness and 1.43MPa center dot m(1/2) fracture toughness.

Keywords

Author Keywords: Zinc; Biphasic; Characterization; Mechanical; Biomaterials; Calcium phosphate; Dopant; Ceramics

KeyWords Plus: TRICALCIUM PHOSPHATE; BONE-FORMATION; IN-VITRO; HYDROXYAPATITE; CERAMICS; NANOPOWDERS; STABILITY; ZN

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Abstract

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Author keywords

Biomaterials; Biphasic; Calciumphosphate; Ceramics; Characterization; Dopant; Mechanical; Zinc

Indexed keywords

Engineering controlled terms: Bioceramics; Biomaterials; Calcium; Ceramic materials; Characterization; Doping (additives); Fracture toughness; Mechanical properties; Powders; Sintering; Sols; Zinc

Beta tricalcium phosphate; Biphasic; Biphasic calcium phosphates; Ceramics; Mechanical; Mechanical characteristics; Sintering behaviors; Sintering temperatures

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1 Dorozhkin, S.V.
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