

Specific roles of sodium for the formation process of manganese-substituted octacalcium phosphate

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ABSTRACT

In the field of biomaterials, octacalcium phosphate (OCP) and biocompatible elements doped with OCP-based materials are attractive materials for new bone substitution because they could be used to control the bone remodeling process in patients with bone diseases. Manganese (Mn) might be a good substitutional element candidate because of its regulation process of bone remodeling for controlling osteo-cellular activities. However, Mn strongly inhibits OCP formation. This study demonstrates that the sodium (Na)-induced OCP formation enhancing the $\text{HPO}_4\text{-OH}$ layer structure of the OCP can overcome this Mn inhibition effect. The Mn-substituted OCP can be fabricated from the coexisting solutions of Na and Mn. The results show that the Mn-substituted OCP-induced Na (OCP-Mn,Na) showed a 4.7° peak in the X-ray diffraction pattern. The sub-peaks at 9.2° and 9.7° of the OCP disappeared, but an extra peak at 9.3° was observed. The thermal stability of the OCP-Mn,Na was significantly lower than that of the conventional OCP because the layer structure of the OCP-Mn,Na decomposed above $\sim 70^\circ\text{C}$. This ionic conjugation to Mn is a unique phenomenon for Na, unlike other cations.

Keywords: Mn, octacalcium phosphate, ion substitution, Na, ion conjugation