

Phase Transition and Morphological Change of Precursor for HAP Formation

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Calcium phosphates, such as hydroxylapatite (HAP) and octacalcium phosphate (OCP), are main components of hard tissues like bone and teeth of higher animals. In particular, HAP is an important material for enamel. All calcium phosphates produced *in vivo* are composed of Ca and PO₄ ions. In solution, HAP forms from OCP, which is precursor of HAP (Nelson and McLean, 1984, Kamitakahara et al., 2009). Then, HAP maintains OCP morphology, i.e., HAP is pseudomorph of OCP. OCP also forms from OCP precursors, amorphous calcium phosphate (ACP) and beta-tri calcium phosphate (beta-TCP) (Johnsson and Nancollas, 1992).

The relation of morphology and transformation from ACP and beta-TCP to OCP is unknown. In this study, we investigate the mechanism of OCP morphology formation when OCP is generated from ACP and beta-TCP.

CaCl₂aq 0.075mol/L and KH₂PO₄aq 0.045mol/L were mixed at high supersaturation rate with buffering. Produced calcium phosphate particles were sampling out at regular time intervals and were observed by field emission scanning electron microscopy (FE-SEM), transmission electron microscopy (TEM), and X-ray diffraction (XRD).

Immediately after mixing, morphology of the produced particles was radial, which was composed of ACP and beta-TCP. Proceeding with time, the radial products were changed from ACP and beta-TCP to OCP keeping the radial structure. Finally, OCP radial crystals were formed. At the time, the tips morphology of radial crystals was changed from needle like to plate like. In addition, a hollow center structure was formed in the OCP plate like crystals.

OCP was heterogeneously nucleated and grew on the radial ACP or beta-TCP structure. This result suggests ACP which located center of radial structure dissolved with proceeding the transformation. Finally, radial OCP crystals were generated.

In conclusion, OCP radial crystal morphology is decided by their precursor morphology. Since OCP is a precursor of HAP, HAP crystals are the pseudomorph of ACP and beta-TCP.

Keywords: hydroxylapatite(HAP), phase transition, octacalcium phosphate(OCP), amorphous calcium phosphate(ACP), precursor, pseudomorph