

Effects on Phosphate Ion for the Phase Changes of Amorphous Calcium Carbonate

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Under the biometric simulated environment, amorphous calcium carbonate (ACC) appears as initiation phase by reaction of calcium and carbonate ions. There is a strong relationship between the ACC phase and the forming crystalline polymorphs. We have shown a significant inhibit effect on the vaterite formation and calcite crystallized instead, and also stabilize ACC under higher PO₄ concentration conditions. We hypothesized that PO₄ ions incorporated in the ACC in that suspect that the adjusting the transfer mechanism of the amorphous phase. The structure and stability of ACC under various PO₄ concentrations were examined using in situ ultra violet/visible spectroscopy (UV/Vis). Further, in order to observe in detail the coupling state, the ex situ measurement of ACC by Raman spectroscopy and by using a Ca ion electrode were performed to evaluation of the presence time of the ACC phase. The bicarbonate buffer was mixed with supersaturated solution of calcium chloride and sodium bicarbonate solution to precipitate the ACC, under conditions of pH ~8.6. By mixing the potassium hydrogen phosphate at a concentration of any carbonate solution side during mixing, PO₄ ions was adjusted between 0-50 μ M concentrations. The ACC contains no PO₄ ions shows a spectrum similar to calcite. However the concentration of PO₄ ions increase, UV / Vis absorption spectrum was carried out changed to spectrum like vaterite gradually. The similar behavior showed in the spectrum observed by Raman spectroscopy. By results of measurements of the molecular weight and particle size of the ACC by scattered light spectroscopy, the increasing both density and particle size of ACC was observed. Ion electrode measurements showed that the residence time of the ACC increased exponentially as increasing PO₄ concentration.

In the presence of PO₄ ion, ACC showed a structure similar to vaterite and its stability was increased. Moreover, the type of forming polymorphs greatly changes in variation of PO₄ ions in μ M scale, and stability amorphous structure is also highly variable. The results suggest a need to consider the effects of coexisting PO₄ ions on ACC, when calcium carbonate tissue is formed in the organism.

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