Systematic Investigation of Calcium Phosphate Minerals and Their Properties on Wet Precipitation

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Calcium phosphate minerals have gained a lot of attention in diverse fields of research and industry, due to their biological and medical signigicance. Physicochemical properties of their crystallinity, morphology, and size play an important role in clinical applications. Hydroxylapatite (HAP) is the most stable calcium phosphate mineral under ambient temperature and natural pH. However, other phases such as monetite and brushite can be formed in oversaturated solutions with respect to calcium phospahtes because of slow crystallization of HAP. In this study, calcium phosphate minerals formed through wet precipitation route is investigated over a range of pH and temperature.

Constant-addition method at constant concentrations of species (i.e., Ca^{2+} and PO_4^{3-}) and injection rate was carried out through the wet precipitation. HAP is precipitated at pH $\geq$8.5, whereas monetite and brushite can be formed by acidic pH or temperature during the synthesis of crystals. Phase change of brushite into monetite is observed in two different paths. Upon thermal decomposition, brushite is dehydtated and converted into monetite at temperature 175-200℃. During 24 hr of wet aging at 60℃, brushite is transformed into mixed monetite and HAP. It is found that the traits of calcium phosphates depend on pH and temperature seriously. At pH 10.0, crystallinity of HAP increases with increasing temperature. It is worthy to note that the morphology of HAP is evolved from lath to needle as synthetic temperature increases. Brushite is formed at pH 6.5, and also platy and tabular in shape whereas it apears needle-like at pH 8.5. Our results suggest that formation and properties of calcium phosphate minerals can be greatly influenced by key parameters, pH and temperature.

Keywords: calcium phosphate, pH, temperature