

Retarding transformation of amorphous calcium carbonate – Synthesis and conditioning techniques

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Amorphous calcium carbonate (ACC) is known to be an important precursor in biomineralisation and is of tremendous interest for material science. A large number of studies and recipes on how to synthesize ACC emerged therefore from different fields. Nevertheless, precipitation of ACC from aqueous solutions without using additives results in rather instantaneous transformation to crystalline CaCO_3 , which makes studies about characterization and tailored use of ACC challenging. Long-time metastable and well-defined “additive-free“ ACC is highly desirable for fundamental research and technical applications, but techniques to fulfil these requirements in decent quantities are rare.

Herein, we present a simple and feasible synthesis route on how to obtain pure ACC in high quantity, which is metastable throughout a month depending on storage conditions. The ACC is prepared by rapid mixing of a calcium- and carbonate-rich solution, instantaneous ACC separation by membrane filtration and freeze-drying. Aspects and parameters influencing the metastability of ACC, in particular the interplay with relative humidity determining ACC’s “lifetime”, are discussed.

Our findings suggest transformation to crystalline polymorphs of CaCO_3 is initiated via a dissolution and re-precipitation process of ACC. Furthermore we observe calcite, vaterite and aragonite formation in the same sample after crystallization of the freeze-dried ACC, which suggests that transformation to distinct CaCO_3 polymorphs depends on physico-chemical conditions during transformation rather than pre-structural cluster formation within ACC.