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Formation of biomimetic carbonate crystals: Particle assembly vs. classical growth

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Calcium carbonate is the most abundant mineral phase in biological hard tissues. It is today believed that biologically mediated carbonate minerals crystallizes from a precursor phase: amorphous calcium carbonate(ACC). During the transition of precursor ACC to crystallized skeletal material a hydrated ACC form goes through an anhydrous amorphous phase. Carbonate skeletal material is a hierarchical composite where at each scale level a mineral and an organic component are closely interlinked. Mineral nucleation and hard tissue formation are organic matter mediated.
In order to understand the formation of carbonate biological hard tissues it is essential to investigate the transition from ACC to carbonate as well as the nucleation and crystallization of the carbonate mineral from the organic component.

Thus, my master thesis project consists of two sub-project:

1. Synthesis and stabilization of ACC and its subsequent crystallization to calcite and/or aragonite. For this purpose I use the following methods: a. Precipitation of CaCl2 and Na2CO3 (mol ratio=1:1) in presence of magnesium additive[1]; b. Supersaturated Ca(OH)2 solution with polysorbate 20 incubated inside sealed desiccator containing ammonium carbonate; c. Precipitation of supersaturated Ca(OH)2 solution in presence of polysorbate 20 [2].
2. The investigation of the crystallization of carbonate mineral from different gels that are model substances for the organic component in the biological hard tissues. I investigate the influence of mineral nucleation, formation and morphology of three different gels: a. Gelatin hydrogel[3], b. Agarose gel and c. Silica gel.

[1] Fitriana Nindiyasari et al. in preparation. [2] Kyubock Lee, Wolfgang Wagermaierl et al., Self-assembly of amorphous calcium carbonate microlens arrays, Nature Communications, 2012, 3, 725.
[3] Fitriana Nindiyasari, Lurdes Fernández-Díaz et al., Influence of Gelatin Hydrogel Porosity on the Crystallization of CaCO3, Crystal Growth Design 2014, 14(4), 1531-1542.

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