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The Effect of β-Glycerophosphate on the Crystallization of Amorphous Calcium Carbonate (ACC)

Calcium carbonate ($CaCO_3$) minerals are widely distributed in organisms as skeletons and hard tissues. This biomineralization process, which controls the formation of $CaCO_3$ in nature, often proceeds via amorphous calcium carbonate (ACC), a metastable precursor phase. However, the mechanisms of ACC stability and transformation remain unclear, particularly the impact of organic phosphates, which play a crucial role in microbial metabolic processes. Here, we investigated β-glycerophosphate (β-GP), a model organic phosphate ligand containing phosphate and glycerol groups, to evaluate its influence on the nucleation and growth dynamics of ACC and on its crystallization to stable $CaCO_3$ polymorphs. Using in-situ UV-Vis spectroscopy, in-situ dynamic light scattering (DLS), scanning electron microscopy (SEM), and X-ray diffraction, we show that β-GP affects the lifetime of ACC, stabilizes vaterite, and influences the sizes of initially formed ACC. These findings suggest that β-GP plays a key role in ACC stability and size, highlighting the relevance of organic compounds in biogenic $CaCO_3$ formation.

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